IBA TECHNICAL REVIEW

20

Developments in Teletext

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IBA INDEPENDENT BROADCASTING AUTHORITY

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20 Developments in Teletext

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Technical Editor: Paul Gardiner, B.Sc., IBA Engineering Information Service

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HEADQUARTERS: 70 Brompton Road, LONDON SW3 1EY. *Tel: 01-584 7011; Telex:* 24345
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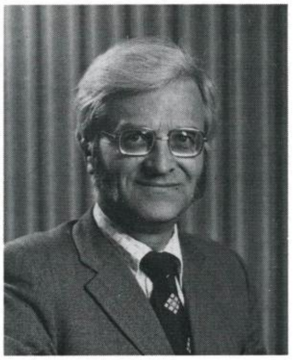
Introduction

by A. L. Witham

Assistant Director of Engineering (Policy)
Independent Broadcasting Authority



Ten years is a long time in television. It was in early April 1973 that the IBA began the first series of experimental teletext-type transmissions of coded data in the vertical interval of its operational television service from Crystal Palace. These first transmissions were seen by representatives of the electronics and receiver industry, members of the Independent Television programme companies and a few others; the first public demonstrations of a teletext service were during an engineering lecture at Birmingham on 30th April 1973 and subsequently during an IEE Conversazione at the Royal Festival Hall. The system was given the engineering acronym ORACLE—'Optional Reception of Announcements by Coded Line Electronics'. Development had been parallel to, but independent of, the BBC's CEEFAX system.

Engineering developments, however, seldom just happen—they stem from ideas and concepts gestated over many months. Teletext was a natural and inevitable progression from investigations over several years into data transmission and identification of picture sources using digital signals in the vertical interval. Thus in Spring 1973 there were two separate, non-compatible systems—ORACLE and CEEFAX. It says much for common sense all round that by mid 1973 there had been set up, jointly with the Home Office and British Industry, a working party from which was to emerge an agreed unified standard for British teletext, capable of providing many more pages at much higher data rate than either of the two original systems.

The 1974 Teletext Specification (modified slightly in succeeding years) remains a triumph of far-sightedness, a progressive and forward-looking specification that paid full regard to the need for relatively low-cost decoding. The establishment shortly afterwards of services that were operational in everything but name is an achievement comparable with the pioneering of British high-definition television in 1936.

Already by 1974 it was being pointed out that 'not very often—perhaps once in several decades—does a modest research project ever show real promise of giving the public something completely new—a broadcasting service totally unlike anything that exists today'. It was foreseen, even then, that 'ORACLE would be particularly useful for the deaf'—optional 'captions' it was stressed could be transmitted on the lower part of the screen, superimposed on the picture.

But it was also appreciated that it would not be easy to establish a large-scale public teletext service. To quote from a 1973 IBA survey: 'The running of such a service involves many questions outside the engineering sphere. What would be the effect of such a service on viewing habits? How would it be financed? Who would run it? How many viewers would avail themselves of the facility in the early days? Would it provide a useful low-cost and specialised advertising medium?'

There were indeed many questions that needed to be answered—in practice it took a number of years to do this—some have still to be fully evaluated. Teletext decoders required the development of special-purpose chip sets and it was not until 1978–9 that teletext-equipped receivers began to appear in reasonable numbers at reasonable cost. Even then it proved difficult to get across to viewers the new concept of an electronic, frequently updated magazine available throughout programme service hours. Only the young responded enthusiastically to keypad control units.

The turning point came in 1981, due in large part to the active intervention of the Department of Industry and the fiscal concessions that encouraged more and more people to watch ORACLE in their homes. It is an information-orientated rather than an entertainment-based service—and the expansion even now is modest—for example in relation to video recorders. But it is fair to claim that teletext is now a firmly established part of the current television scene.

In 1982 alone industry could report a consumer off-take of almost a half-million teletext-equipped sets. The tenth anniversary sees almost one-million homes receiving ORACLE and CEEFAX. Britain's lead in this technology is indisputable. Even in 1982 North American broadcasters were still cautiously testing the water: teletext, it was being said, 'has a lot in common with religion. It takes a lot of faith and it's non-profit'.

Yet in the UK the teletext magazines already have a readership equivalent to that of a quality newspaper; the cost to the consumer is considerably less.

In this Technical Review the recent developments—that provide an added potential for the future—are described together with the current work aimed at hard-of-hearing viewers. Teletext is the marriage of television and the computer. The union promises to be a happy one.

GEORGE McKENZIE, B.Sc., C.Eng., FIERE, joined the IBA in 1968 to become Head of the newly-created Automation and Control Section. He previously spent ten years in industry working on numerous projects connected with automation and computer techniques. His career has also included ten years in BBC Designs Department. He is married, has two children, and lives in Hampshire.

Teletext—The First Ten Years

by G. A. McKenzie

Synopsis
The author reviews the developments that have taken place since the first experimental teletext transmission in 1973. Enhancements to the present (referred to as 'Level 1') broadcast system as described which allow for future extensions to provide a greater range of display attributes and improved graphics (Levels 2–5). Mention is also made of telesoftware techniques, which enable coded instructions (or even complete computer programs) to be conveyed to an 'intelligent' receiver incorporating a microprocessor.

THE ORIGINS

It is not generally known that a 50-page teletext magazine containing up-to-date information was broadcast experimentally in the London area as long ago as April 1973. The data signal which carried the information was to the bi-phase 2.5 Mbit/s standard which had been previously developed by the IBA for its SLICE system,[1] and is used currently by EBU on the Eurovision network. Then, as now, the teletext system employed a fixed coding format. This was a deliberate decision to improve the ruggedness of the system in the presence of interference.[2] The computer equipment in the IBA London Laboratories was that used for earlier experiments in the computer analysis of television signals and reported in, among other publications, the first volume of this IBA Technical Review series.[3] Lines 16 and 329 were used for the transmissions and each line signalled ten characters of the forty-character rows of text. Outline details of the system characteristics were published in mid 1973.[4]

A public demonstration at a June 1973 IEE Conversazione featured live updating from information telephoned from the demonstration stand, illustrating the immediacy of the new medium.

At this time the British television industry and the Post Office were very interested in the IBA ORACLE system and in the similar (but technically different) BBC CEEFAX. The Post Office was itself developing a system to give an information service (later called viewdata) using the public telephone network, but planned at that time to provide its customers with a special viewing unit for the text. The strong interest of the television receiver industry in the teletext development, with the potential that millions of television receivers would eventually be equipped for teletext reception, was probably the main factor which persuaded the Post Office to give its very considerable support to a British teletext standard and to co-operate with the industry in the development of combined viewdata/teletext/television receivers and adaptors.

The IBA had first proposed (in November 1972) to the BBC and the British Radio and Electrical Manufacturers' Association (BREMA) that the three bodies should co-operate to define a unified National technical standard for data broadcasting. In the event, the first technical meeting to this end could not be arranged until July 1973. This and many

subsequent meetings were held under BREMA chairmanship. The Standardising Committee was supported by concurrent experimental work in its members' laboratories, and by field measurements of experimental transmissions. The work proceeded rapidly and in such a co-operative spirit that it was possible to publish the first specification for a national teletext system in October 1974.[5] This technical specification depended upon contributions, on a broadly equal basis, from the IBA, BREMA members, and the BBC. Regular experimental public services began in 1975 and some technical changes were introduced in 1976 to accord to the final (September 1976) standard,[6] which introduced improvements in detail to the 1974 specification. The draft final standards for both teletext and viewdata were presented to an overflow international technical symposium at the IEE London, on a January afternoon in 1976.

THE FIVE LEVELS OF TELETEXT

The development of UK teletext since 1976 has been carefully arranged in a series of compatible steps. These steps are represented in the description of the system in CCIR Report 957,[7] which was formulated during the Study Group 11 Technical Committee meetings in Geneva in the Autumn of 1981.

The five steps or 'levels' are described very briefly below. The interested reader is referred to the CCIR report for more detailed information and for definitions of the technical terms.

LEVEL 1.—This is the present system which has been in public service for many years. There are some optional extensions for linked pages, basic page check word, programme or network label and data for equipment control, including time and date in Coordinated Universal Time (UTC). Eight colours are available, and a very efficient 'block mosaic' facility is provided for graphics.

LEVEL 2.—In addition to the capability of Level 1, this provides for multi-language text and a wider range of display attributes, which may be non-spacing. There are sixteen colour shades available, which may be redefined on a page basis.

LEVEL 3.—This introduces dynamically redefined character sets, (DRCS), which allow for extra characters (e.g. non-Roman, such as Arabic or Chinese), and for improved graphics. Fine-line graphics are possible which, within certain limitations, demand less storage in the receiver than does Level 4. 4,096 colour shades are available, of which sixteen may be used at a time on a page.

LEVEL 4.—This is the level of alphageometric coding. Computing power is needed at the teletext receiver which receives only geometric primitive commands for construction of the graphics. The system demands a further increase in storage capacity at the receiver. As many as 32 colours may be used on a page, chosen from over 250,000 shades.

LEVEL 5.—At this level full-definition still pictures may be presented. In principle, these pictures may be superior to any transmitted by means of conventional television systems, since the only limitation in the quality of the picture is that due to the display device.

Figure 1 shows a representation of a well-known engineer taken from a page of experimental ORACLE transmissions in 1973. The limited graphics resolution at Level 1/2 meant that a large part of the screen had to be used for the illustration. Figure 2 shows the improvement effected by the Level 3 DRCS technique. Figure 3 shows a 'tracing' using the experimental IBA Level 4 system. There is no illustration of Level 5, as at this level it is possible to present full photographic quality.

Concerning Other Characters

The Level 1 system follows the International Standard ISO 646, which permits a series of 'national option' character sets. The principle is that, in certain positions in the character coding table designated 'national option' positions, the characters may be replaced by those needed for other languages. There may be six alternative 'national' character sets at Level 1.

The provision for extension of the character repertoire in this way was criticised, particularly by French authors, on the grounds that the capability to deal with languages other than English was too limited. This criticism was first made in connection with the announcement of a technically very different French teletext system called Antiope. The announcement of Antiope[8] caused other countries at first to hold back from adopting the UK system. This situation, likened by some to the PAL/SECAM controversy of earlier years, persisted even after UK semi-conductor decoder sets became available in production quantities, while the French system still existed only in the development laboratory. This matter was fought out in the various international standardisation committees, some of which are listed in Table 1. The British position was helped greatly

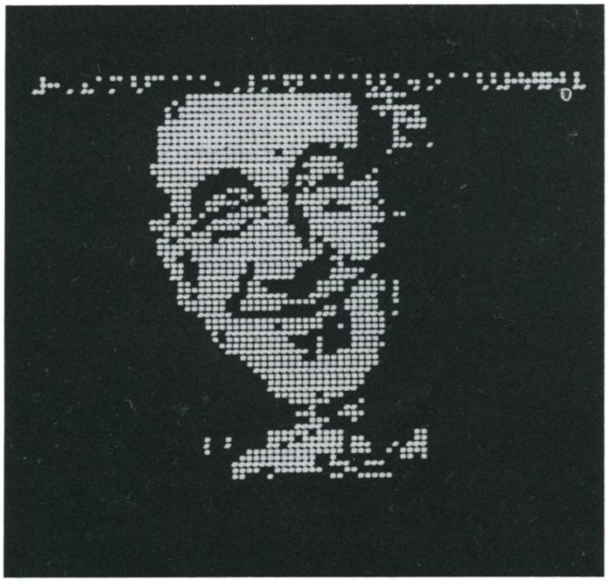


Fig. 1. An example of Level 1/2 teletext graphics.

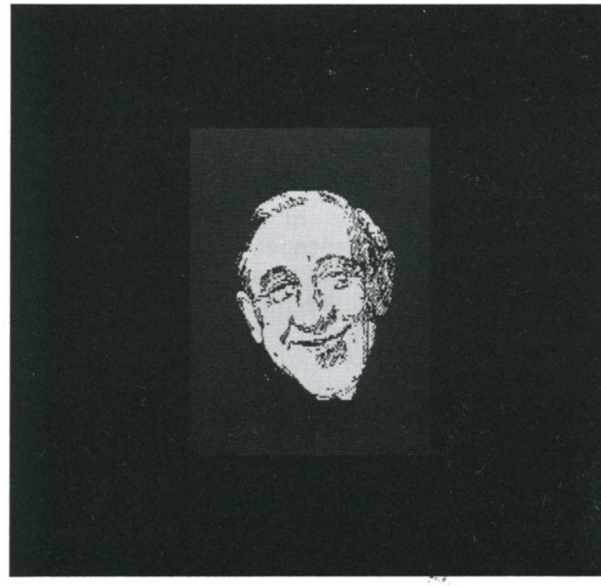


Fig. 2. The improvements resulting from the Level 3 DRCS technique.

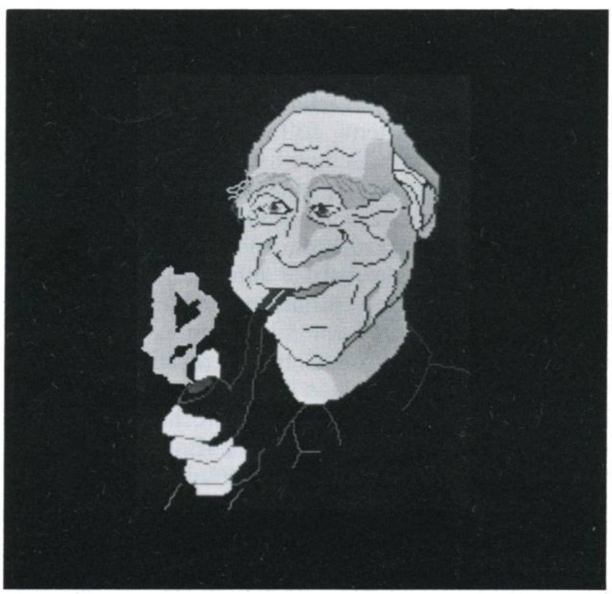


Fig. 3. A similar illustration, composed using Level 4 graphics.

when the UK firm Mullard Ltd. put forward a 'Polyglot' system, which in its third version formed the basis of Level 2 UK teletext. The position at the beginning of 1983 shows a widespread adoption of the British system in many overseas countries. This is illustrated by the numbers of teletext receivers now in use in Europe (Table 2).

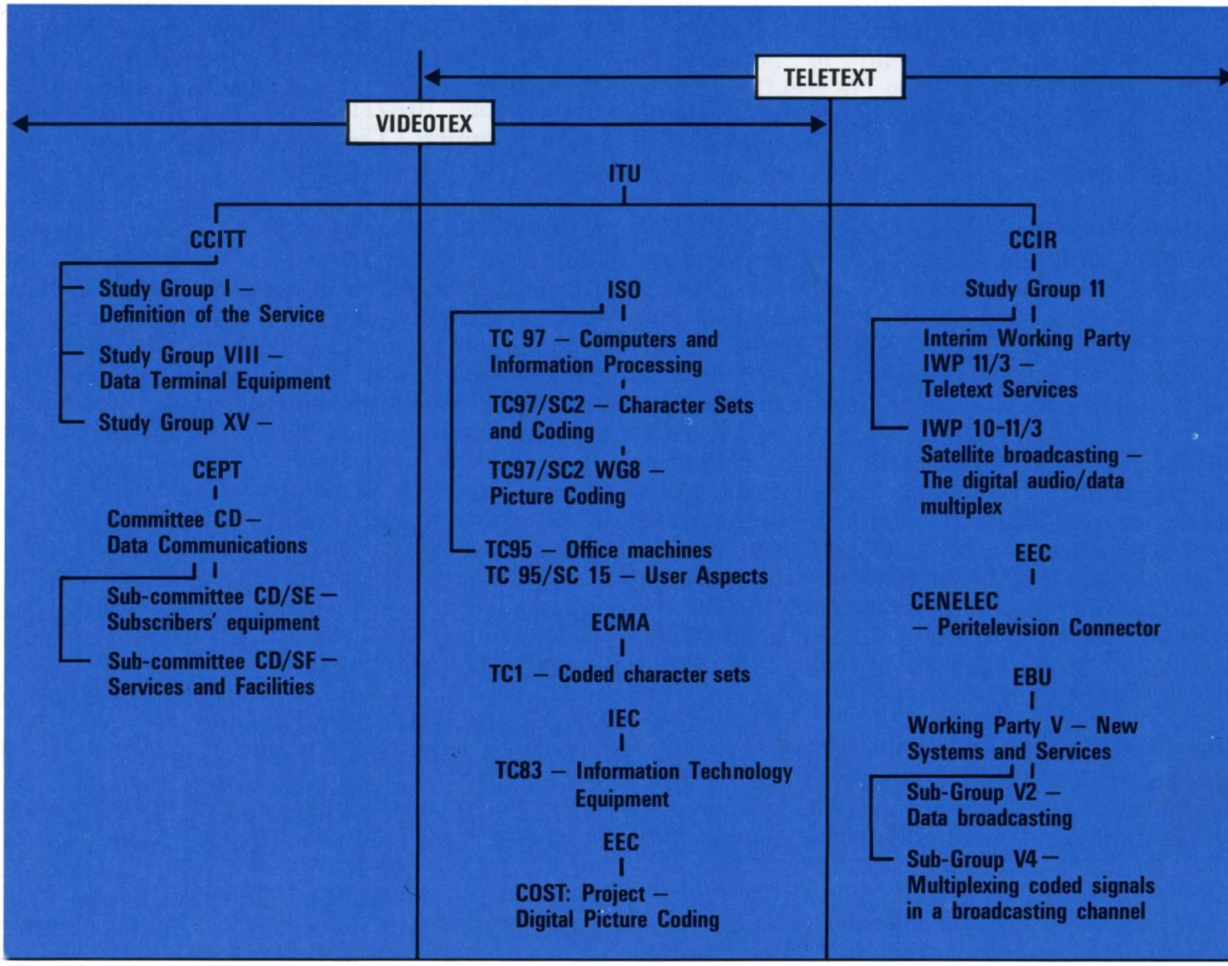
Another criticism of the early (1974) UK system concerned the display facilities. The system did not then allow for a difference in the colours of adjacent displayed characters, unless there was an intervening space. Thus adjacent words could be coloured differently but differently coloured letters had to be spaced out across the page. This facility is very rarely needed by teletext editors, but the corresponding gaps between coloured areas on a map, for example, were not liked. This problem was solved through the 'hold graphics' control in the 1976 specification version and later, more elegantly but compatibly, as part of the Level 2 specification. These Level 2 features were demonstrated publicly, from experimental pages of the broadcast ORACLE service, in London in 1980.

DRCS—Dynamically Redefined Character Sets

The pressure for yet more extensive sets of characters for texts in different—even non-Roman—languages led to the proposal that special character shapes should be 'downloaded' to the receiver. The matrix describing the special shape was defined 'dot-by-dot', rather than by definition of a general shape by the single seven-bit code from a standard character coding table. The dot-by-dot coding is, of course, much less efficient, but once defined the special characters may be used repeatedly and in this case the efficiency is improved.

It was realised from the start that the DRCS system

TABLE 1. INTERNATIONAL COMMITTEES AT PRESENT ACTIVE IN TELETEXT AND VIEWDATA OR IN ASSOCIATED MATTERS.



Glossary

CCIR	International Radio Consultative Committee	ECMA	European Computer Manufacturers' Association
CCITT	International Telegraph and Telephone Consultative Committee	EEC	European Economic Community
CEPT	European Conference of Postal and Telecommunications Administrations	IEC	Commission Electrotechnique Internationale
EBU	European Broadcasting Union	ISO	International Organisation for Standardisation
		ITU	International Telecommunications Union

TABLE 2. ESTIMATES OF THE NUMBERS OF TELETEXT RECEIVERS (EARLY 1983) IN EUROPEAN COUNTRIES WHICH OPERATE THE UK TELETEXT SYSTEM.

The United Kingdom	P	1,000,000
Austria	P	150,000
Belgium (Flanders)	P	45,000
Denmark	P	30,000
Finland	P	30,000
West Germany	E	200,000
Italy	E	*
The Netherlands	P	200,000
Norway	E	*
Switzerland	E	10,000
Yugoslavia	E	*

P = Public Service; E = Experimental Service; * = figures not available.

would allow an improvement in graphics since an illustration may often be broken into a limited set of suitably-shaped characters. Such diagrams could then be presented with better resolution than is possible at Level 1. In the space of each character position on the screen, a rectangular dot matrix is used. This is typically 12 dots high and 10 dots wide, which may be compared with the 2×3 'blocks' of the Level 1 system.

'Picture-ORACLE' (and -CEEFAX)

The first publicly demonstrated Picture-ORACLE transmissions were shown during the International Broadcasting Conference at Brighton in September 1980. The pictures, of approximately half television resolution, occupied approximately one tenth of the area of the displayed page and each took six seconds to transmit using two lines per field. The specially-coded pages were inserted into the live ORACLE service and thus again demonstrated the strength of the UK system in its capacity for compatible extension.[9] The 'Picture-Prestel'[10] system was used, adapted for broadcast use by engineers of the Independent Television Companies Association (ITCA).

More recently, very high quality still pictures as part of live teletext pages have been demonstrated by the BBC. These demonstrations involved the transmission of millions of bits of data and showed what will become practicable with high capacity services using full-field teletext (broadcast or cable) and satellite transmissions.

SUBTITLING SERVICE

One of the great benefits of the teletext service is that it may be used to provide a special 'caption' service for television programmes. This service is optional and viewers who do not wish to see the subtitles need not do so. The service is still in its infancy, and development has been stimulated by the results of excellent work done at Southampton University during a joint IBA/ITCA/Southampton University Research project. The chapter by A. Lambourne describes this work in detail.

MORE LINES FOR TELETEXT—'REGIONAL ORACLE'

As previously mentioned, the tests of teletext in 1973 used one line per field for transmission. There were problems with some domestic receivers due to visible interference to the displayed picture. These problems were gradually overcome, chiefly by correct adjustment of receivers. The Teletext Specification allows for the use of sixteen lines per field for teletext. The television industry was asked, therefore, to ensure that future receivers should not be upset by data transmission on any of the lines of the field-blanking internal. Of course, many years must elapse before all receivers of old design are taken out of service, but it has recently become possible to increase the number of lines used for teletext from two to four per field (lines 15, 16, 17, 18 and 328, 329, 330 and 331). Tests are currently (January 1983) in progress using two more lines per field: lines 13 and 14, 326 and 327.

The use of additional lines obviously allows a faster rate of data transmission. This may be used to increase the size of the data base, or to reduce the average access time, or a combination of these. A more convenient organisation of the transmission becomes possible too. For example, one of the lines in each field has been used in ORACLE transmissions to facilitate 'Regional-ORACLE' services, now available in Scotland, the Channel Islands and London.

MEASURING EQUIPMENT FOR TELETEXT

Early in the development of teletext it was realised that although teletext data was to be conveyed along with television signals, the results of television signal measurements to established procedures could not alone provide assurance of the correct transmission of teletext.[11]

Because it was seen that the success of the new service would depend crucially on the satisfactory

performance of teletext receivers, the IBA developed, during 1973–76, a device known as DELPHI[12] to test teletext receivers and decoders. It is certain that this equipment was available early enough, albeit in prototype form, to influence the design of teletext decoders and semiconductor implementations, then still at the laboratory stage. DELPHI is now manufactured under licence by Philips Industri OG Handels A/S of Denmark.

Special test equipment was needed for every part of the chain—origination, network, transmitter and receiver. To assess teletext signal quality, first manually-operated[13] then automated[14] equipment was developed. The latter equipment uses a microcomputer to calculate teletext distortion parameters directly from the sampled and digitised teletext waveform.

British Industry is now foremost in the world in the supply of teletext measuring and transmission equipment. The chapter by Peter Mothersole gives further information on this aspect.

'INTELLIGENT' TELETEXT RECEIVERS

It will soon become economic to introduce a microprocessor into the television/teletext receiver. More advanced teletext facilities can then be provided including response to 'telesoftware' which involves the downloading of computer programs to the intelligent receiver.

Independent Television pioneered telesoftware broadcasting, making the first transmissions early in 1977. This was widely publicised and demonstrated (e.g.[15,16]). Mullard Application Laboratories assisted in the design and manufacture of a simple demonstration telesoftware television receiver. The work was reported to the UK National Teletext Standardisation Committee to encourage telesoftware standardisation.

By 1979, a report commissioned by the ITCA concerning a suitable programming language for telesoftware had been made available.

The early history of teletext is, in a way, being repeated in the development of telesoftware in that Independent Television and the BBC have initially adopted different approaches. The Independent Television approach is to provide for new easy-to-use services for the viewer, who may be completely unaware that a computer resides within his television set. The BBC entry to the field concentrates on the use of a separate home computer. These differences appear to have been reconciled in the 'protocol' part of a National Telesoftware Standard which is expected to be available soon. Telesoftware has an important part to play in the future in easing the user's access, not only to data services, but also to an increasing number of vision and sound services.

Intelligent teletext receivers also allow computer graphics to be introduced, including movement and reorientation of the displayed graphics. This expansion (Level 4)[17] of display facilities would ease the user's assimilation of the information. There is a long-recognised relationship between clarity of illustration and effectiveness of communication.

SUMMARY AND CONCLUSIONS

The co-operative effort which successfully integrated the early teletext work in the laboratories of the IBA and the BBC gave the United Kingdom a national teletext standard ahead of any other country. In the succeeding years Antiope, Telidon and other factors intervened to prevent a rapid adoption of the British system.

Partly to counter this opposition the specification of the system was extended by defining a series of compatible 'levels' at which the various 'enhanced' features claimed by rival systems could be introduced. The facilities offered at each level are, in fact, often superior to those of other systems.

The UK is foremost in the development of measuring and networking equipment for teletext and again reference is made to other articles in this Review.

Finally, telesoftware is seen to have a vital role in the development of future teletext services.

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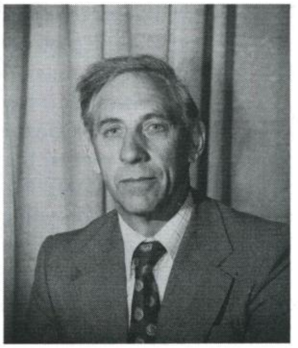
GERALD CROWTHER received the B.Sc., in engineering from Imperial College, London. He joined Mullard Limited in 1950 in their application laboratory. He is presently Head of the Mullard Application Laboratory with responsibilities for the application of all components to television, radio communications, telecommunications, computing and domestic appliances. He has a prime role within Philips for teletext and viewdata. His experience includes work on radiation monitoring equipment, simple control systems, electronic telephone exchanges, calculators, nano-second logic systems,



computer interfaces, and consumer electronics. He has been part of and contributed to the evolution of teletext and viewdata since their initial conception some eight years ago.

Teletext Enhancements—Levels 1, 2 and 3

by G. O. Crowther

Synopsis
Two stages of enhancement compatible with the present teletext system (Level 1) are described in detail. Level 2 offers a wider character repertoire and a greater choice of display attributes. Level 3 introduces dynamically redefined character sets (DRCS) which allow for extra (non-Roman) characters and improved graphics.

INTRODUCTION

When teletext was first introduced, it was felt to be essential that it should be a simple system. The system should not carry the penalties of a more sophisticated approach designed for the future, either in terms of increased transmission time or decoder costs, in favour of making teletext as attractive a concept as possible.

Nevertheless, the desirability of enhanced levels of teletext was appreciated from the outset, and the decisions then taken anticipated the need to permit upward-compatible adaptions to be made. A hierarchy of five distinct levels, from that presently used in the UK to one capable of displaying still pictures with a resolution limited only by the display device, have been extensively defined. As will be seen, to retain compatibility, these enhancements are based on the display and transmission formats already established, but offer valuable additional features—notably Dynamically Redefinable Character Sets (DRCS), one of the most powerful and cost-effective editorial additions to current teletext.

DISPLAY/TRANSMISSION FORMATS

The format of the teletext signal on a transmitted TV line consists of three portions:
(*a*) Synchronisation group
(*b*) Address
(*c*) Data

This is known as a 'packet'. (In the past it has been called a 'row' with an 'address'.) The packet 'address' is made up of two parts:
(*a*) Magazine code (3 bits)
(*b*) Packet number (5 bits permitting 32 packets)

The packet coding has, until recently, been called the 'row address' of which only rows 0–23 were permitted at Level 1. Packet/row codes 24–31 have to be ignored by Level 1 decoders. The UK system

permits a decoder to be designed with a simple one-to-one relationship between the packet numbers, the memory location and the final display location as illustrated in Fig. 1. It is this principle that gives the combination of a low-cost decoder and system ruggedness. Packet 0 (Row 0) is defined as a 'super' packet and contains more addressing information than the normal data packets (1 to 23).

A page is started and terminated by packet 0. Packets of data with the same magazine number which are transmitted between two packets 0 all belong to one page. Packets of other magazine codes, however, can be interleaved.

EXTENSION TECHNIQUES

All planned or proposed teletext extensions should adhere to the following criteria:

(i) Basic systems should not be burdened with addressing overheads associated with more sophisticated systems.

(ii) Excessive spare coding should be avoided to minimise user frustration.

(iii) Decisions taken must allow for the inherent unpredictability of future requirements.

(iv) All extensions must be compatible or be able to co-exist with basic systems.

With these criteria in mind, a number of mechanisms have been incorporated within the basic system, some of which have already been tentatively reserved for known enhancements. The final use of others has still to be defined. The use of Packets 24 to 31, for example, has been defined. Of particular importance is the Packet 27 for linked pages and Packet 26 for page-associated data.

To allow for optimum growth within the system, 'unhook' mechanisms have also been defined. These mechanisms comprise a single code in each code dimension that is reserved for future extensions, and which is ignored by basic systems. By transmitting these codes, additional pages or transmission features become available, without affecting decoders unable to provide them. Future extensions can be added provided that similar unhook mechanisms are incorporated in any existing extension—a technique analogous to the addition of

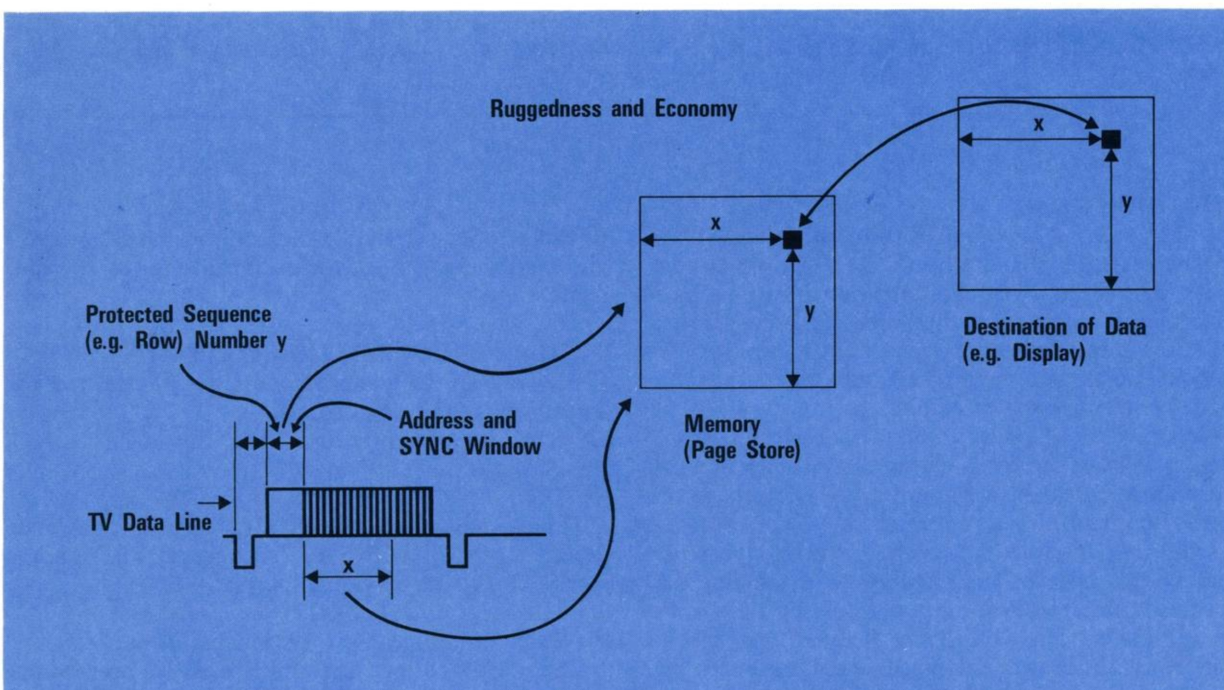


Fig. 1. The teletext system—a direct relationship between packet numbers, memory and display locations, designed to give ruggedness and economy.

telephone numbers as larger and larger geographic areas are required to be addressed.

LEVEL 2 TELETEXT

The features at Level 2 were determined by three main pressures:

(i) A wider character repertoire to cover all European languages and cross-border viewing.

(ii) The challenge of the French Antiope system with its ability to change colours of characters without an intervening space.

(iii) Editorial, operational and user feedback from the current service.

In the latter category come such items as pastel colours. In addition, there is automatic or linked-page operation and a service data row including station identification, programme information and page number of the index page if other than 100 (these are available as options also at Level 1).

The main task has been to devise a coding technique which retained the inherent ruggedness and simplicity of the original Level 1 but permitted the wide increase of the coding necessary to enhance the system. Considerable use is made of Packets 24 to 31 for this purpose.

It is proposed to examine first the coding techniques necessary to give the extra display features at Level 2 within the constraints of transmitting eight-bit codes. In an interactive wired system it is normal to employ code extension techniques based on ISO 2022. However, in the non-interactive broadcast situation the error pattern and operating conditions are fundamentally different. Therefore, a slightly different strategy has been chosen for Level 2 which is still based on, and has a simple one-to-one relationship with, the interactive coding scheme.

Coding Scheme for Level 2

To appreciate the new coding scheme, it is useful to examine the relationships between Level 1 teletext and the ISO standards.

In the UK system, deviations from coding

Teletext Character Code

Bits												
B7 →					0	0	0	0	1	1	1	1
B6 →					0	0	1	1	0	0	1	1
B5 →					0	1	0	1	0	1	0	1
B4 ↓	B3 ↓	B2 ↓	B1 ↓	Col → Row ↓	0	1	2	3	4	5	6	7
0	0	0	0	0				0		P		P
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			"	2	B	R	b	r
0	0	1	1	3			£	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K		k	
1	1	0	0	12			,	<	L		l	
1	1	0	1	13			—	=	M		m	
1	1	1	0	14			.	>	N		n	
1	1	1	1	15			/	?	O		o	

Control Characters (Columns 1 & 2) displayed as Spaces

Fig. 2. Teletext character codes.

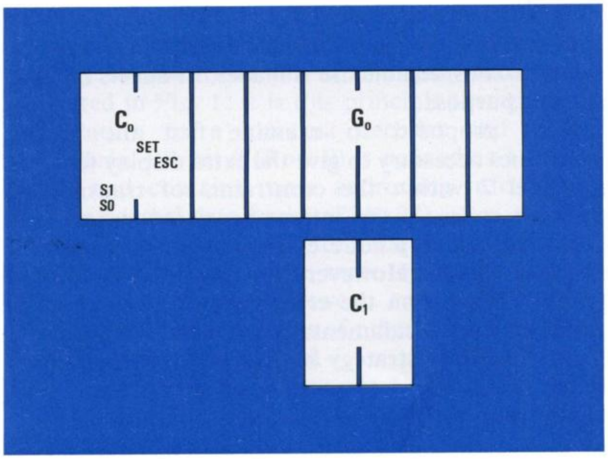


Fig. 3. The use of escape codes to alter display attributes.

standards have been made to achieve the well-established ruggedness in reception at minimum decoder cost and data transmission time of the UK teletext system.

ISO 646 and ISO 2022 in their normal formats are based on seven-bit code (128 combinations) of which two combinations are reserved for a printing space and delete (see Fig. 2). The positioning of the display on the screen is achieved by counting from a reference point, with a strict relationship between the display location and the order of arrival of the data bytes. If it is desired to give attributes to the text display such as colour, further coding is required; this is achieved by transmitting the control code ESC (column 2) and following this with a code in columns 4 and 5 which is now interpreted as a display command rather than its normal character representation (see Figs. 3 and 4).

However, there would now be discontinuity between transmission sequence and display location. Thus, if for any reason the ESC code cannot be recognised, elaborate procedures would be necessary in the receiver to prevent the display format from being disrupted. The same arguments apply to the use of codes CR and LF to terminate one row and start the next.

For these reasons, UK teletext does not employ the codes in columns 0 and 1 of the ISO table but achieves their functions in other ways. There are thus no discontinuities in the transmission, and there is a direct relationship between transmission order and display format.

For teletext, not all the control codes from columns 0 and 1 are required. Those which could be employed are divided into three groups:

(1) Display format FF, CR, LF
(2) Display enhancement ESC
(3) Designation of other character sets: SI, S0, SS2, SS3.

A standard format has been implemented to cover the display formatting for Level 1 and the enhanced system, and there is thus no need for the codes LF and CR. For escape routines, a simple system has been implemented for Level 1 and a single character set only is permitted thus eliminating the need for character set extension. A more general implementation of ESC has been incorporated for the enhanced system and has been linked with the need for extended character sets.

(i) DISPLAY FORMAT. The Hamming-protected address sequence coding at the start of each packet gives precise instructions for the display locations of the data bytes which follow. There is thus no ambiguity of display format, and experience has shown that the byte synchronisation mechanism is very reliable.

(ii) LEVEL 1 ESCAPE ROUTINES. In Level 1, a single character-set (C1) is defined which contains all the picture attributes (colour, etc). According to ISO 2022, these would have a code in columns 4 and 5 and would follow an escape character in the normal ISO data stream. Since in the normal teletext data stream no codes in columns 0 to 1 are transmitted, there are

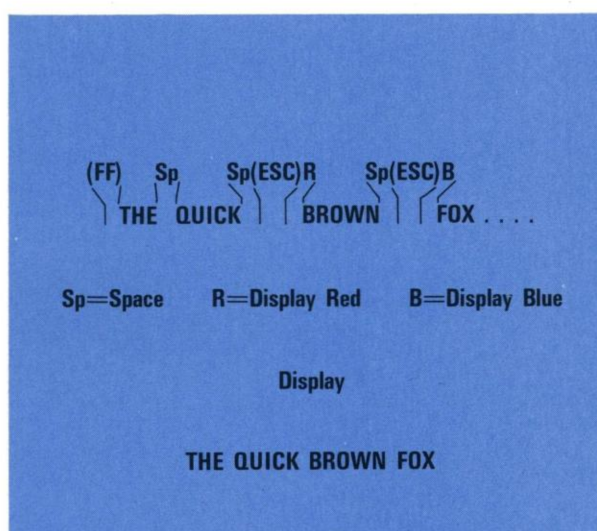


Fig. 4. ISO 646 transmission.

32 codes not employed in the transmission of data. These codes are instead employed to transmit the C1 set of control characters. There is thus a very simple and unambiguous translation of the ISO code to teletext code.

Finally, by ensuring that all attribute codes (serial attributes) are allocated a display location and displayed as a space, they can be inserted into the data stream without fear of a reception error or an attribute code disrupting the display format.

(iii) CONTROL CHARACTERS AT LEVEL 2. At Level 2, the codes for ESC, SI, S0, SS2 and SS3 have to be implemented in a compatible way with Level 1. The display address at which these discontinuities occur is transmitted with Hamming protection and located in a transmission packet in such a way that the decoder can locate the Hamming data in the stream without ambiguity.

The control data is transmitted in a packet marked as number 26. This packet has the format shown in Fig. 5. It will be seen that the packet is made up of a series of address data pairs consisting of three bytes. The first two bytes are Hamming protected. The third byte is parity protected and contains the associated data. The 16 bits of the first two groups are allocated as follows:

Address	6 bits
Control, etc.	5 bits
Hamming Protection	5 bits

Table 1 gives the allocation of the codes in the control section and in the associated parity-protected byte. In its simplest form, the coding could have been implemented in such a way that the control codes had a one-to-one relationship to the ISO control codes and the following parity byte would contain the instruction.

TABLE 1: PACKETS '26' MODE DESCRIPTION CODES CHARACTER-SPACE ADDRESS GROUP

MODE DESCRIPTION	FUNCTION	DATA BITS 1 TO 7 INCLUSIVE
Space group 00000	Alphanumeric	Bits 1, 2 and 3 respectively red, green and blue foreground
Space group 00001	Alphanumeric × 2 height	Bits 5, 6 and 7 respectively red, green and blue background
Space group 00010	Alphanumeric × 2 width	Bit 4 flashing
Space group 00011	Alphanumeric × 2 size	
Space group 00100	1st DRCS latching shift	
Space group 00101	2nd DRCS latching shift	
Space group 00110	Mosaic normal	
Space group 00111	Mosaic smoothed	
Space group 01000 to Space group 01011	Pastel colours 4 codes	Bits 1 to 7 inclusive with the 4 designation codes define 16 foreground and background colours
Space group 01100	Non-spacing attributes	Bit 1 separated mosaic/underline alphaphanumerics, bit 2 boxing, bit 3 conceal, bit 4 reduced intensity foreground, bit 5 reduced intensity background, bit 6 no response
Space group 01101	1st DRCS single shift	Bits 1 to 7 inclusive define the DRCS character
Space group 01110	2nd DRCS single shift	
Space group 01111	Special character from supplementary set	Bits 1 to 7 inclusive define the supplementary set character
Space group 10000 to Space group 11111	Accents from supplementary set	Bits 1 to 7 inclusive define the associated primary set character

The simple relationship has not been implemented for three reasons:

(*a*) Certain instructions can disrupt the display format and are therefore Hamming-protected (e.g. double height).

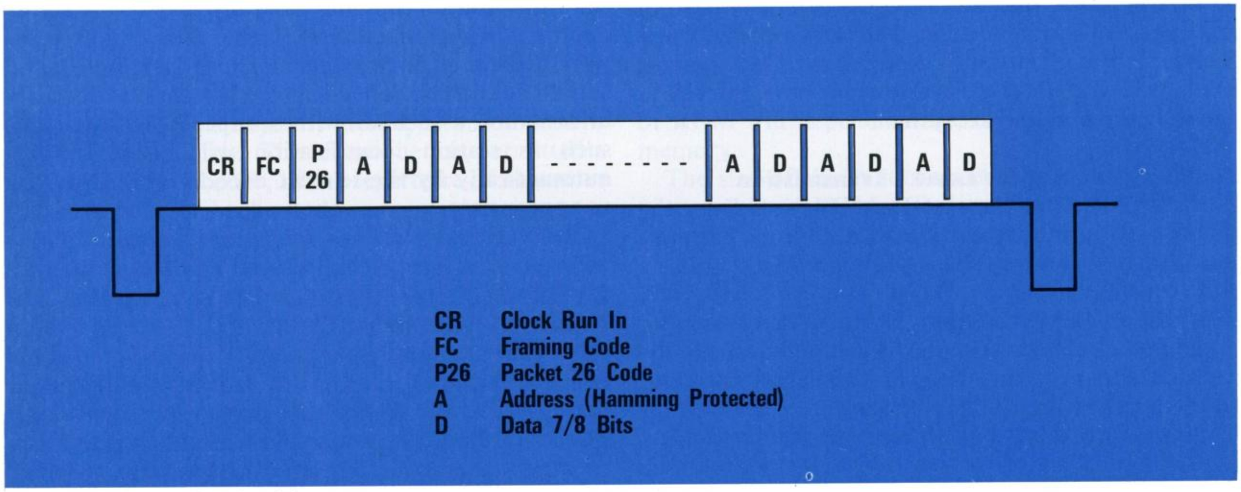


Fig. 5. The format of Packet 26.

(*b*) Compatibility with Level 1.
(*c*) Reduced transmission time is desirable.

From Table 1 there is a simple, unambiguous relationship between ISO and the teletext codes. It should be noted that the processing required for the conversion is identical to that which would be required in a receiver to convert an incoming ISO transmission into a suitable format for display purposes.

In the enhanced receiver, coding has been provided for the following features:

(1) All attribute changes without a space
(2) Extended mosaic graphic set
(3) Full ISO Latin-based alphabet
(4) 32 pastel colours out of a selection of 4,096
(5) Two modes of dynamically redefinable character set.

In the scheme proposed above, Level 1 decoders will not respond to data on Packet 26. An editor can thus determine the fall-back position of any given page.

In the case of picture attributes, the higher level decoder will continue to take note of all Level 1 instructions but allow these to be overwritten by data on line 26. Thus, for example, a Level 1 decoder could display a word in a single colour while the higher level decoder could for example display a single character flashing and in a second colour without the need for a space.

The same also applies in the case of alphabets. For example, 'ü' could be displayed in the higher level decoder and the Level 1 decoder could default to 'u' or 'ue' under editor control. The extra space would be allowed for at the end of the word. The important feature of this technique is that the *editor*, not the decoder manufacturer, determines the default display at every level. This feature is not achieved in any other known teletext system.

The Ruggedness of the Level 2 Transmission

The inherent ruggedness at Level 1 arises from the simple association between packet address, memory and display location (see Fig. 1). Packet address acts as a sequencer.

In a Level 2 transmission it is anticipated that more than one Packet 26 will usually have to be transmitted. For this reason, an extra byte of addressing has been added to Packet 26 giving four Hamming-protected bits. These give a sequencing function and allow up to 16 Packet 26's to be associated with a page. In fact, this has been restricted to 15; the 16th code has been reserved for future extensions in much the same manner as Packets 24 to 31 at Level 1.

The memory organisation of a Level 2 decoder will be identical to that for Level 1 except that 2 kilobytes are now required. One kilobyte will perform the Level 1 function exactly as in the past. The second memory contains the Packet 26 data as transmitted. There is therefore again the simple relationship as shown in Fig. 1 and when errors do occur there will be no cumulative disruption of the display.

Packet 26 will be transmitted immediately after Packet 0 to ensure instant correct display at Level 2.

Other Extensions at Levels 1 and 2

A number of the spare Packets 24–31 have been reserved for specific purposes of particular interest (Packets 27 and 30). Up until the present, decoders have stored only a single page of memory. This means waiting for every page requested. In the future, however, decoders with multi-page memories will become available. These decoders can be made to select automatically the user's favourite pages. However, more interestingly, it is planned to transmit the page codes for all the pages associated or 'linked' with the page just selected by the user. In this way the decoder can automatically select and store these pages for immediate use.

As an example, if the news headlines have been called up by the user, pages with more details will automatically be collected and stored ready for instant viewing.

Remote control and digital tuning systems with on-screen display are now standard, but it is desirable that the station be identified in a more positive manner. It is planned that Packet 30 should not be page-associated as are Packets 26 and 27, but that it should be an independent code. In this packet, information associated with the specific transmission such as station identification will be picked up automatically by the teletext decoder and displayed as appropriate.

DYNAMICALLY REDEFINABLE CHARACTER SETS—LEVEL 3

DRCS is potentially the most powerful and cost-effective editorial addition to teletext and viewdata services of all the refinements that have been discussed. DRCS not only gives unlimited extensions to the character repertoire but can permit sophisticated graphics, as illustrated by Figs. 6 and 7.

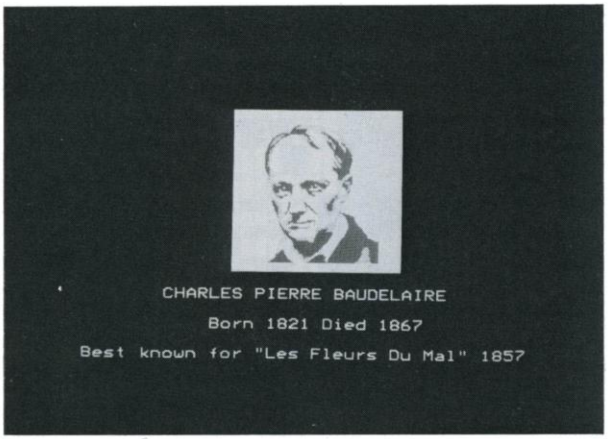


Fig. 6. An example of the use of DRCS.

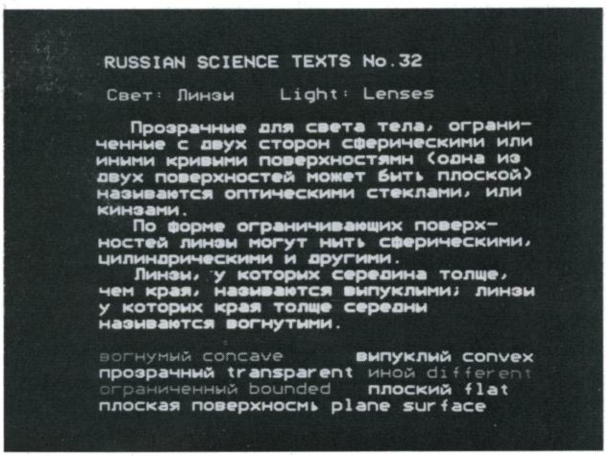


Fig. 7. The use of DRCS to provide alternative alphabets.

To date, teletext and viewdata transmissions have been converted into visual displays by means of a read-only memory, in which the visual shape of the character to be displayed is stored as a dot pattern within a fixed matrix. The technique has permitted a very economic decoder, as the repertoire of character shapes to be stored is limited.

In setting-up viewdata or teletext standards, however, a difficulty arises in selecting the repertoire of characters and symbols within a specific economic limit. The DRCS concept allows the editor to define up to, say, 100 additional characters which are employed as part of the graphic repertoire for a specific page or group of pages in the normal way. Examples of when DRCS can be of great value are complex languages (Russian, Greek, Japanese, Chinese, etc.), company emblems or logos, mathematical symbols, specific symbols for timetables, and drawings.

In essence, the DRCS transmission is a number of facsimile transmissions, each over the limited area of the character matrix. These matrix blocks can be positioned on the screen under the control of the editor either individually or in groups to form a total picture. The DRCS concept involves two specific stages in transmission:

(*a*) The downloading of the dot pattern of each matrix and the allocation of a code to the matrix. (It should be noted that the codes form part of the normal text coding structure but are not uniquely allocated for all time.)

(*b*) The normal page transmission in which the codes defined above will be designated for display at a specific location, or locations, on the screen.

The order of transmission will probably be the same as that implied above.

Decoder Design for DRCS

The block diagram shown in Fig. 8 shows the main structure of a teletext/viewdata decoder incorporating DRCS. In normal use the source-defined ROM will be idle. Data from either source (viewdata or teletext) will be stored in the data memory in coded form. The information is then converted as required by the fixed-character ROM into a video signal for display.

In the case of a page containing DRCS, the DRCS data is first transmitted and then stored in a memory which is labelled source-defined ROM. The coded information for the page is then transmitted and stored in the data memory in the normal way. For display, both the fixed and source-defined ROM will be employed to create the display signal. The choice of ROM will depend on the code stored in the data memory.

The size of the random memory employed as the source-defined ROM will depend on the number of characters to be stored and the character matrix chosen. In general, it will require one to two kilobytes of memory. It is this small increment in cost which is the attractive feature of DRCS.

Four problems have to be addressed in setting-up a standard for DRCS:

(1) The matrix structure
(2) The coding of the matrix transmission
(3) The allocation of codes to the DRCS matrix
(4) Compatibility between all levels of decoders.

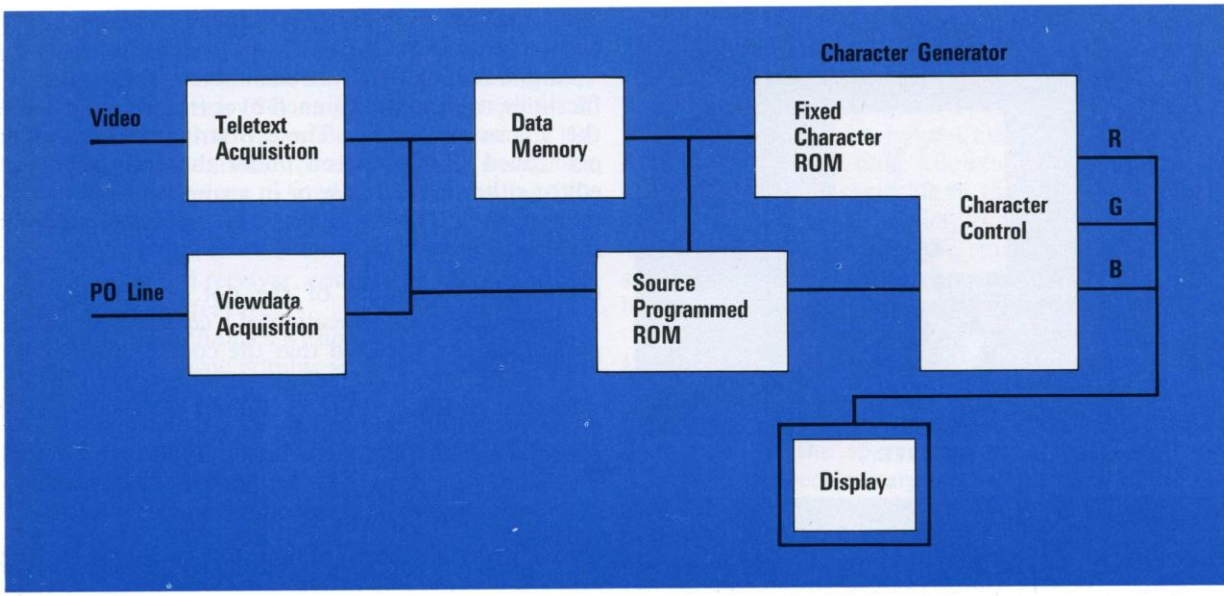


Fig. 8. Block diagram of a teletext/viewdata decoder incorporating DRCS.

The Matrix Structure

The choice of matrix structure is perhaps the most important aspect of the DRCS concept and the subject of most disagreement within the standards committees. The reason for the disagreement is that the choice of matrix dot pattern for DRCS also imposes this same matrix on the internal pre-programmed matrix for the bulk of the text display. This factor removes an important design criterion from decoder design. The optimum matrix will depend on a wide range of factors such as:

(*a*) *The display device*
Flat panel devices, present and future colour picture tubes, etc.

(*b*) *Associated drive circuit bandwidth*
Set-top adaptors, video drive circuits, technology, etc.

(*c*) *The viewing conditions*
Distance, light levels, etc.

The so-called '6/12-dot' proposal retains the maximum flexibility within the present bandwidth constraints set, for instance, by set-top adaptor requirements.

The 6-dot pattern represents the minimum that can be employed for the Latin-based alphabet, and can be used in a wide variety of applications without serious bandwidth restrictions. Furthermore, the 6-dot pattern may be employed to give 80 characters across a row on more advanced colour picture tubes. This gives the possibility of displaying two pages side by side.

The only criticism of the 6-dot pattern has been that the shape is aesthetically poor (see Fig. 9). Here, the 12-dot approach manages to retain the basic bandwidth of the 6-dot system whilst giving greater flexibility in character shape than can be achieved by any other proposals. The 12-dot pattern also permits three dots for either a vertical bar or space. The latter, in particular, enhances readability at a distance. Figure 10 shows a selection of fonts using the 12-dot capability and illustrates its flexibility.

In the normal usage, considerable advantage can be achieved by utilising the full 12-dot resolution on details such as the points in the letters 'N' and 'M'. Although these strictly cannot be fully resolved by the lower bandwidth systems the visual effect is still good. The amount of high frequency energy is also very small.

The other application of the full 12-dot resolution is to achieve a grey scale such as is employed in Fig. 6. For the future, 12-dot capability gives plenty of scope for high-definition pictures.

Considering the question of vertical resolution, this is very largely determined by the raster pattern of the TV system, although a small compromise can be made between the number of rows of data and the number of raster lines allocated to the character matrix. It is generally agreed that 10 raster lines per

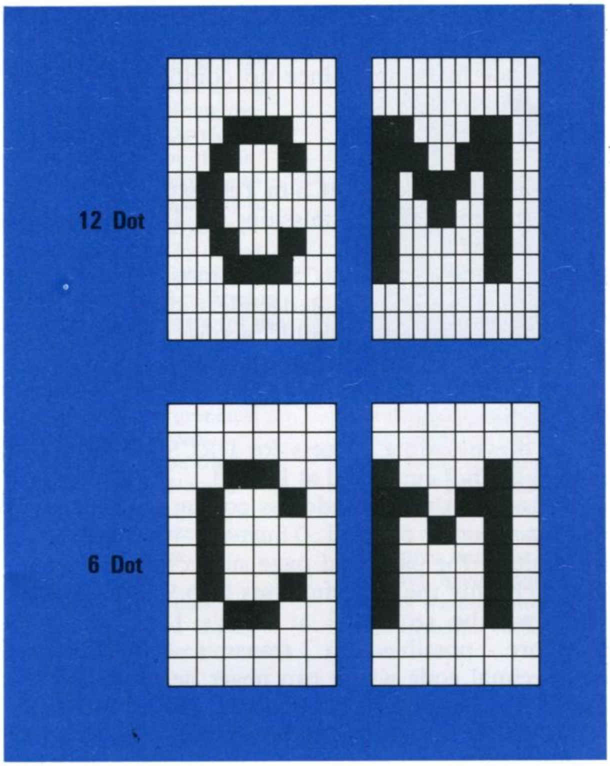


Fig. 9. Comparison between 6-dot and 12-dot characters.

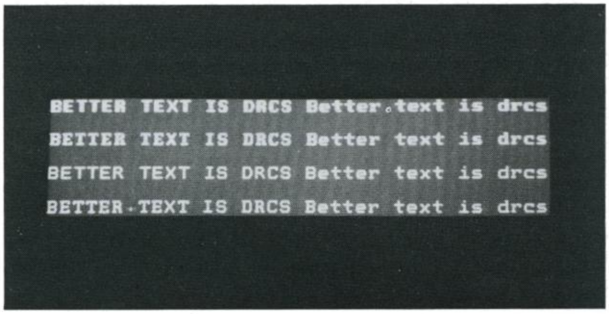


Fig. 10. An illustration of the use of the 12-dot approach to create a variety of character fonts.

character matrix is the best compromise, although 12 or 13 would be better for accented characters. If allowance is made for overscan this permits 24 rows on a 625-line system.

Colour DRCS

In the above description the character matrix is assumed to be divided into the foreground or background. Each of these areas can be given one of the colours of the basic system. In many applications, however, it is desirable to be able to define the colour of each individual dot in the matrix (pixel). This can be achieved by the colour mode within the coding scheme of the 12-dot transmission.

Figure 11 shows the matrix of the character in the colour mode. It is a 6 (horizontally) $\times$ 5 or 10 (vertically) matrix in which the colour of each pixel is defined by four bits. Four bits were chosen since in the 6×5 colour mode this gave the same decoder memory requirements as the basic 12×10 system. In the 6×10 colour mode the number of characters stored will be halved. Alternatively, the memory could be doubled for specific applications. In its simplest form the four bits can be used to define one of the eight basic colours and two levels of intensity. However, by a simple extension of the system the four bits could be employed to define up to 16 adaptively defined colours.

To achieve the adaptive colours it is proposed to transmit codes as part of the DRCS data defining the colours to be employed in the particular picture. The 16 colours would be chosen from a larger colour chart. The colours would be coded simply by allocating either four levels (two bits) or 16 levels (four bits) of intensity for each for the three primary

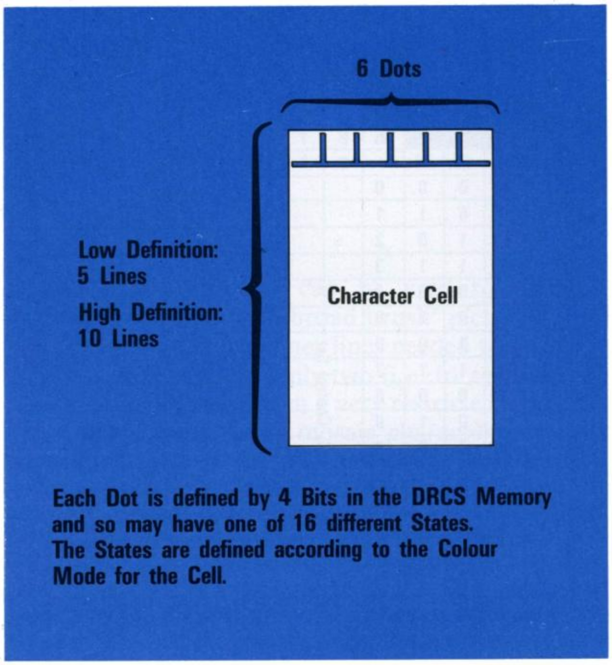


Fig. 11. A colour-mode DRCS character.

colours. These codes of the 16 pre-defined colours would be stored in memory.

In operation, as the pixel data is read from the main DRCS memory the four-bit code of each pixel would be converted into one of the 16 pre-selected colours. This facility gives the possibility of a relatively high definition display employing 16 pastel colours from a large colour table. The memory required for the colours can be accommodated in the main DRCS memory.

Coding of the Matrix Transmission

The downloading of the dot pattern has to conform to the normal 7 or 8-bit transmission of the main service. It is also desirable that it conforms to the ISO coding structure.

In the 6/12 dot proposal this can readily be achieved as shown in Fig. 12 in which the normal ISO format 7-bit code table has been reproduced. In the code table columns 2 through to 5 have been reserved for transmitting the dot pattern and the 64 codes give all possible combinations of 6 dots. The remaining codes in columns 6 and 7 are reserved for status and instructions during the downloading. There is a simple relationship between the transmitted code and the displayed dot pattern. This is of particular importance in teletext since no complex processing will be required.

DRCS Code Table Allocation

				B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1
B4	B3	B2	B1		0	1	2	3	4	5	6	7
0	0	0	0	0								
0	0	0	1	1								
0	0	1	0	2								
0	0	1	1	3								
0	1	0	0	4								
0	1	0	1	5								
0	1	1	0	6								
0	1	1	1	7								
1	0	0	0	8	C_0 Control Set			DRCS	Data Codes		DRCS	Instruction Codes
1	0	0	1	9								
1	0	1	0	10								
1	0	1	1	11								
1	1	0	0	12								
1	1	0	1	13								
1	1	1	0	14								
1	1	1	1	15								

Fig. 12. DRCS code table allocation.

The Transmission of DRCS in Teletext

The problem of transmission of DRCS can be divided into two parts:

(1) How to send the DRCS data in such a way that Level 1 and Level 2 decoders do not display disrupted or unintelligible pictures on the screen.

(2) How to distinguish between the downloading process and the positioning of the new characters on the screen.

The downloading process for DRCS makes use of page codes not employed at Level 1.

At Level 1 the page address coding is transmitted as binary-coded decimal. Thus, six 4-bit words are transmitted for page and page sub-code numbering, of which only the combinations 0 to 9 of each 4-bit word will be requested at Levels 1 and 2. It is therefore possible to transmit pages using hexadecimal code which can never be requested by, or disturb, Levels 1 and 2 decoders. The page A0 sub-code 3F7F has been reserved for downloading DRCS.

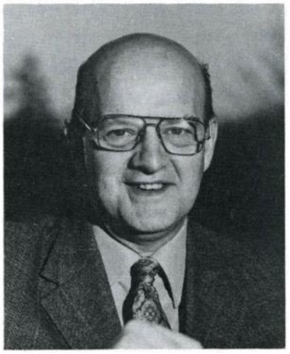
In its simplest mode of operation the Level 3 DRCS decoder will always look for this page and load the DRCS memory. This memory then acts as part of the display ROM to produce the final picture (see Fig. 8). The positioning and choice of DRCS characters will be determined by the data in Packet 26 of the selected page as already described at Level 2.

The fallback to Level 1 will, again, use the same principles as those described earlier for Level 2, under the control of the editor. For DRCS it is possible that, in some cases, there will be no simple fallback. In such a case the page can be made invisible to Level 1 decoders by transmitting the page with code A0 accompanied with any sub-code except 3F7F.

CONCLUSIONS

This chapter has described how the current teletext system can be enhanced in two important stages. This has been achieved with complete compatibility with the existing system. At the same time, the inherent ruggedness of the original system has been maintained and possibly enhanced.

ROY VIVIAN, B.Sc., C.Eng., MIEE, was educated at Dulwich College and the Universities of Reading and London. Since joining the Experimental & Development Department of the IBA in 1968 he has led projects to investigate the feasibility of off-air quality analysis of television signals by digital computer (the 'Lichfield Experiment') and to develop a colour VDU system for use in the Croydon Regional Operations Centre (ROC). Recently he has been concentrating on graphical enhancements (alpha-geometrics) for the UK Teletext system. He was previously with Elliott Automation, where he was responsible for the specification and development of pilots' head-up and head-down display systems. His earlier experience



covered a wide field ranging from design of analogue and digital computers to high fidelity sound equipment, UHF and VHF mobile and fixed receivers. He has been involved with semiconductor applications since the very early days, having designed and built the first known British transistor radio receiver.

Level 4—Teletext Graphics using Alpha-geometric Coding

by R. H. Vivian

Synopsis

An enhanced form of teletext is described, in which complex graphics may be displayed while using a very high transmission efficiency, comparable with that of Levels 1/2. This is made possible by the transmission of 'alpha-geometric' instructions as teletext data, which are then decoded by an 'intelligent' receiver incorporating a microprocessor. Typically, use of a display memory of 38 kilobytes allows a resolution of 320×240 pixels, improving the resolution of Level 1 mosaic graphics by a factor of more than thirteen.

INTRODUCTION

Since the joint issue in September 1976 of the Broadcast Teletext Specification by IBA, BBC and BREMA, many alternative teletext proposals have appeared, which purport to overcome what are seen to be limitations inherent in the original specification.

A hierarchy of compatible enhancements or 'levels' has been proposed, introducing a range of new and improved features which equal and in many respects surpass the characteristics of competing proposals. According to this hierarchy, Levels 2 and 3 together dispose of virtually all the alleged textual shortcomings of the present Level 1 system.

Although many of the transmitted teletext pages demonstrate how well the coarse 6-cell 'mosaic' characters of Level 1 can be used to compose 'banner' headlines and 'broad brush' pictures, there is no provision for the finer lines needed to present a diagram or road map. Only two (i.e. foreground and background) colours from a very restricted range can be present in any single mosaic character and, as a consequence of the serial attributes, these colours cannot both be varied simultaneously between successive character spaces, even using the 'hold graphics' facility.

IMPROVED GRAPHICS

Levels 2 and 3 overcome many of the graphical limitations. For example, Level 2 introduces

'smoothed' graphics, in which the rectangular outlines of the 6-cell mosaics are augmented by alternative characters with sloping boundaries, formed by diagonals joining corners of the original cells. Level 2 also permits the use of pastel shades and the overwriting by any available character, including graphics, of a space previously occupied by either a control or a displayed character. Overwriting is controlled by 'ghost' rows, which are lines of data with row addresses beyond those of the 24 character rows displayed on the television screen, but which nevertheless may be stored in local memory.

Level 3 extends the range of graphic symbols, in principle without limit, by the use of dynamically redefined character sets (DRCS), transmitted as part of the teletext magazine.[1] DRCS would normally consist of single-bit character matrices defining the foreground and background picture elements or 'pixels' from which the characters are formed on the screen, but there are also proposals for a full colour version, aimed at removing the two-colour restriction mentioned earlier. At the other end of the scale, Level 5 is capable of presenting 'alpha-photographic' or fully graduated colour still pictures, the quality of which can exceed that of the television picture itself.[2]

THE CASE FOR ALPHA-GEOMETRICS

In view of the foregoing, it might appear that all necessary facilities can be provided by Levels 1, 2, 3 and 5 and that consequently there is no need for alpha-geometric coding, i.e. Level 4. A more detailed examination shows that this is not necessarily the case.

Level 3 DRCS provides an excellent method of presenting characters not permanently stored in receiver memory. Although eminently suitable for transmitting small groups of graphic characters, this technique becomes less attractive when larger areas require graphical treatment. A circle with a diameter approaching the height of the teletext display requires some 80 unique characters for satisfactory DRCS representation. At a transmission rate of two dynamically redefined characters per data line, this represents an equivalent overhead of almost two extra teletext pages and, once received, the data for these characters would occupy more than a kilobyte of local storage. The same circle generated by an alpha-geometric instruction would require only 49 data bits which, with parity, would be transmitted as a group of 7 bytes, representing less than 0.73% of the capacity of a single Level 1 page.

In the unlikely event of all available character rectangles requiring unique redefinable characters, the overhead would extend to 20 extra transmitted teletext pages and 16 additional kilobytes of receiver memory. If the characters were of the fully coloured variety, transmission time and storage would be increased even further.

The chapter by G. Crowther deals with a practicable DRCS system in which the extreme case would not be catered for and the extent of the DRCS coverage would be limited by receiver storage to a fairly modest level of two fonts of 96 characters each. This would lead to a corresponding restriction in the total screen area available for this sort of graphical treatment, although it may be extended by character repetition whenever the composition makes this possible.

Level 5, on the other hand, is envisaged as being capable of presenting full-screen still pictures. Current experiments on these lines have involved the use of up to 100 teletext pages of data and a full video frame store in the receiver. Falling memory costs are likely to allow this storage requirement to be met economically before the end of the present decade. Even with improved coding techniques, the access time per picture would still limit this form of presentation if conventional terrestrial field-blanking time transmission were to be employed. However, Level 5 still pictures would seem perfectly viable if a full television channel were made available for 'full-field' teletext. A similar still picture service might also form part of a direct satellite broadcasting system.

LEVEL 4 ALPHA-GEOMETRICS

A Level 4 display is defined by a list of instructions, similar to a high-level language computer program in which the operation codes are compacted into two digit hexadecimal numbers transmitted as single 8-bit bytes as teletext data. An example of such an instruction set is given in Table 1, which shows the full set employed in the transmission of experimental alpha-geometric pages forming part of the broadcast ORACLE magazine. The alpha-geometric coding of Level 4 provides a transmission efficiency comparable with that of Levels 1/2, even where extensive use is made of complex graphics. Greater receiver memory is required than for Level 3, and microprocessor control is mandatory.

Level 4 teletext provides the necessary graphic elements for the construction of geometrical figures,

TABLE 1: ALPHA-GEOMETRIC INSTRUCTION (AGI) SET

AGI NUMBER	NAME	ARGUMENTS	TOTAL NUMBER OF BITS INCLUDING LEAD-IN
00	LINE	C,X1,Y1,X2,Y2	52
01	POLYGON	C,X1,Y1,X2,Y2,..XN,YN*	
02	CIRCLE	C,X1,Y1,R	49
03	MAJOR ARC	C,X1,Y1,X2,Y2,R	63
04	MINOR ARC	C,X1,Y1,X2,Y2,R	63
05	CHAIN CODE	C,X1,Y1,M1,M2,..M(N)*	
06	BOUNDARY INFILL	C,X1,Y1	33
07	INFILL	C,X1,Y1	33
08	WRITE	C,X1,Y1,TEXT,*	
09	ERASE	C	14
0A	DELAY	T	14
0B	FLASH ON	T	14
0C	FLASH OFF	T	14
0D	DISPLAY NEXT PLANE		10
0E	TOGGLE INVISIBLE/VISIBLE GENERATION FLAG		10
0F	CHARACTER DEFINITION ASCII, RUN LENGTH CODING,*		
10	DEFINE MACRO	MACRO NUMBER	14
11	END MACRO DEFINITION		10
12	MACRO CALL	MACRO NUMBER,X1,Y1	35
13	COLOUR PALETTE	C,RED,GREEN,BLUE	35
14	STANDARD PALETTE		10
15	LINE THICKNESS	THICKNESS	14
16	CONTINUATION CODE		10
17	PROGRAM END		10
18	ACQUIRE LEVEL 3 DRCS		10

The alpha-geometric instruction (AGI) set used in the experimental transmission of Level 4 teletext as part of the broadcast ORACLE magazine. Asterisks (*) denote that the argument list is terminated by a delimiter, the form of which varies with the instruction. The AGI 'numbers' are hexadecimal and represent the compacted operation codes employed.

charts, graphs and maps and the creation of freehand drawings. It is also possible to fill bounded areas with any one of 16 colours selected from a virtually continuous range. Displays are built up from and stored in the form of pixels which are square in shape and have a height equal to a pair of picture lines (one from each field). In the present system each Level 1 character space is represented by a matrix 8 pixels wide and 10 pixels high, so that the conventional display area of 24 character rows of 40 columns becomes 320 pixels wide and 240 pixels high. Each pixel requires 4 bits of storage in order to provide 16 selectable colours, so that a full display image plane comprises some 38 kilobytes of memory. To allow for future improvements in resolution as the cost of memory decreases, display locations are defined on the basis of a 640×480 matrix.

The currently adopted experimental standards are seen to be at variance with the 10×12 character matrix advocated for Level 3 teletext. Harmonisation may, however, be achieved by a number of alternative courses. First, the geometric convenience of the square pixel could be reconciled with the Level 3 standards by a software translation from 12 to 8 pixels per character space horizontally. Alternatively, the square pixel could be modified to a rectangular shape with a consequent horizontal increase from 320 to 480 pixels for the normal teletext display area. Display area storage might then be rounded up to the binary figures of 256×512 pixels, resulting in an increased memory plane size of 64 kilobytes. Taking into account the probable continuation of the reduction in memory costs, this may not represent a very significant factor in say, five years time.

Also to be taken into consideration in determining pixel size is the now generally accepted 13.5 MHz digital sampling rate for video. For storage and processing there are obvious advantages in employing a compatible standard for picture (alpha-photographic) teletext. Superposition or combination of levels would transfer these constraints to Level 4 alpha-geometric teletext. To maintain correct horizontal/vertical relationships the resulting pixels must correspond to 74ns intervals along a scan line which, for a compatible 10×12 character matrix, would reduce the current 40 µs teletext frame width of Level 1 to 35.5 µs. The corresponding width of the experimental Level 4 teletext frame using square pixels is 43 µs, although the existing memory planes are sufficiently large to allow use to be made of the full screen width.

The similarity to a computer allows alpha-geometric instructions to become a subset of a future telesoftware[3] programming language, which should both simplify the use of Level 4 graphics in presenting telesoftware output data and, conversely, extend the tools available for generating alpha-geometric displays, particularly where animation is involved. The relationship to telesoftware is also extremely pertinent in terms of requisite hardware, which is virtually the same in either case.

ALPHA-GEOMETRIC INSTRUCTIONS (AGI)

The geometric approach affords a very efficient means for encoding geometric patterns. A detailed description of the experimental instruction set of Table 1 has been given elsewhere.[4,5] Some of these instructions relate to geometric primitives (line, arc and circle), while the polygon instruction obviates the need to repeat the co-ordinates of line junctions. For a line, only the start and finishing points are needed

and a circle can be defined as a centre and radius. Circular arcs require two end points and either a third included point, or a radius. For irregular features, such as coastlines, an incremental line technique has been found to be more effective since it allows these features to be represented both more accurately and more efficiently than is possible using a filled polygon approach. Having defined a starting point, each subsequent section with a length equivalent to either one or two pixel transitions is then converted to a group of four bits. Freehand lines drawn, for example, on a graphics tablet may also be conveniently coded in this way. The graphics potential of Level 4 is illustrated in Figs. 1 and 2.

Line thickness can in all cases be varied by means of a separate instruction preceding the geometric commands which it is to affect. Sixteen selectable colours are available for lines and infilled areas, the latter being implemented in two different ways. The first accepts any contiguous bounded area, whereas the second recognises only boundaries of its own colour, obliterating all enclosed detail.

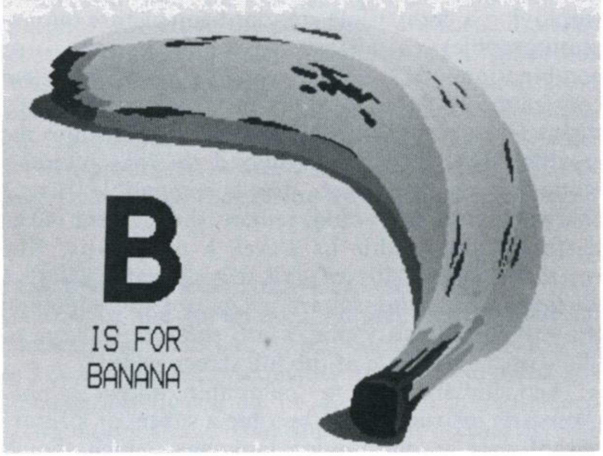


Fig. 1. An example of Level 4 graphics. The banana is composed of 2638 bytes of data.

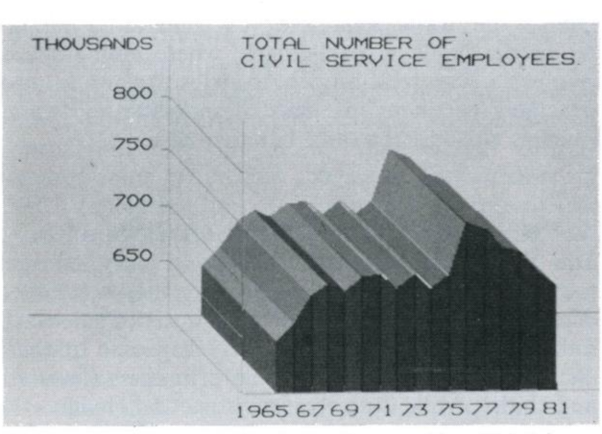


Fig. 2. A further example of Level 4 graphics. This picture contains 1475 bytes of data.

Colour

The colour of a line or area is specified by a 4-bit argument incorporated in each of the relevant graphical instructions. These 4 bits correspond with the 4 bits stored for each pixel of the display and represent the 16 colours which are available for that display. The 16 colours can be chosen from a palette of 262,184 colours. The colour instruction specifies the red, green and blue (RGB) components to be associated with a particular colour number and includes three ancillary bits, two of which define a foreground/background priority.

This priority has been found necessary in order to introduce 'antialiasing' in the form of rounding of characters and lines. The process employed is similar to that used in almost all current teletext receivers to improve the appearance and readability of text, but in the case of the lower levels, character detail is implicitly 'foreground'. If the process is inverted so that the background is rounded onto the foreground, diagonals (such as the strokes of the letter 'x') virtually disappear and, instead of becoming clearer, the text is very difficult to read.

When display data is stored in a pixel plane memory, the background/foreground information is discarded unless an additional bit plane is provided for its retention or, as here, it is incorporated in the colour definition. As far as is known, no similar procedure has been disclosed in any alternative alpha-geometric proposal, implying that the visual quality of characters generated by other alpha-geometric systems would be inferior to those displayed by simpler alpha-mosaic teletext systems.

Character Rounding

Rounding is performed by hardware at scan time and individually modifies the information presented by both odd and even fields, according to a simple algorithm. This greatly improves the appearance of text and also benefits the smoothing of the incremental code used for boundaries and map outlines. The effects of rounding are illustrated in Fig. 3. Although the process enhances the appearance of incremental lines and of straight lines

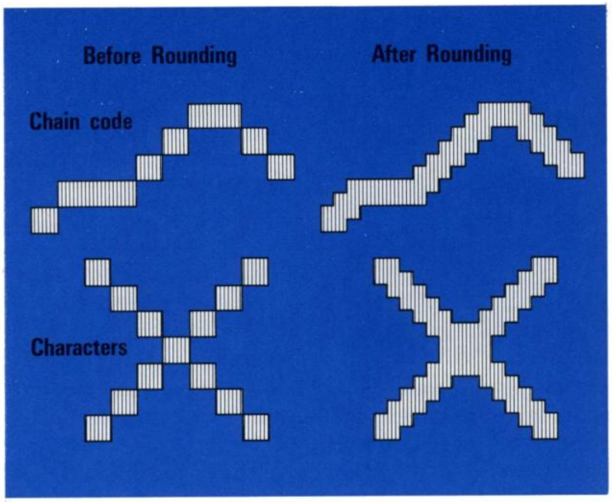


Fig. 3. The effects of character rounding.

with slopes in the region of 45°, it is unfortunately less effective in the case of lines with directions close to the horizontal and vertical. In these latter cases it may be that the only really satisfactory solution involves modifying the contents of pixels adjacent to the line by means of software, before display. The effect is equivalent to doubling the number of pixels both horizontally and vertically, and so necessities quadrupling of the display memory size.

Two different types of rounding logic have been tried. In the first, the display logic tests for diagonally-adjacent pixels and rounds if the attribute information permits. In the second, a test is also made upon the third or corner pixel in the frame and if the third pixel has the same colour number as the diagonal pixels then rounding is prohibited. This prevents rounding of the inner corners of a display (e.g. a square or an 'E').

The advantage of keeping corners square is apparent on text and on the chain code, but a filled block of colour (e.g. a filled circle) will have a number of pixel corner groups at its perimeter which would not then be fully rounded. If rounding occurs for any diagonal then rounding of filled shapes is automatic.

One of the major requirements when drawing on the image plane is to ensure that drawn lines are of roughly the same intensity irrespective of the direction in which they are drawn. The average intensity of the line is given by:

$$\frac{\text{Number of illuminated pixels}}{\text{Line length}}$$

For a small element of the diagonal line, non-rounding gives an average intensity of approximately 0.7 pixels per unit length. When rounding is introduced, the intensity increases due to the extra quarter pixels and the line intensity increases to an average of 1.06 pixels per unit length (see Fig. 4).

The character sets used in Level 4 are similar to those of the lower levels, but the ability to address individual pixels means that character positions need no longer be confined to the rows and columns of those earlier levels. Variable character width and spacing are also feasible, although the advantages are questionable unless a general improvement in appearance is introduced simultaneously, which calls for both higher resolution storage and software antialiasing.

Level 3 DRCS are also available to Level 4 and are supplemented by run-length-coded characters of indefinite size, yielding more efficient coding in cases where the detailed graphic symbols concerned extend beyond one or two normal character areas. As an example, chess pieces originally each requiring 6 redefined characters showed an overall saving of 30% when recoded in this way (see Fig. 5).

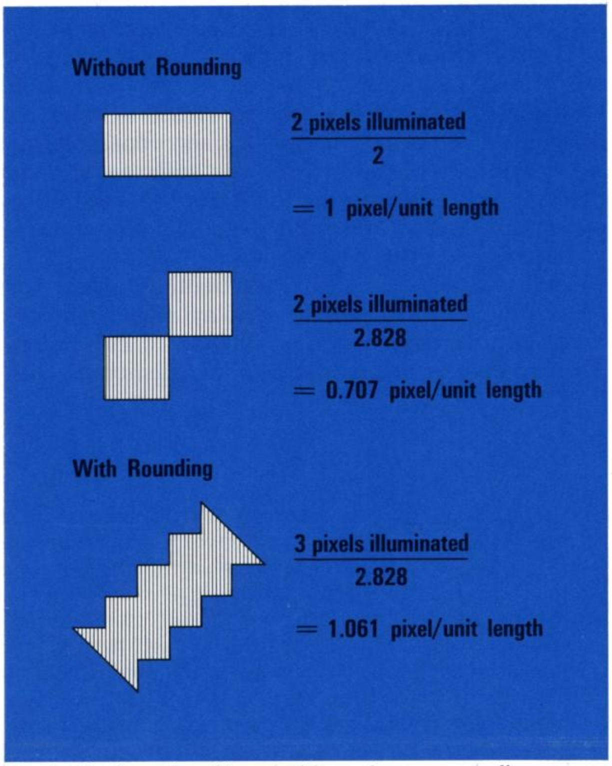


Fig. 4. Line intensity with and without character rounding.

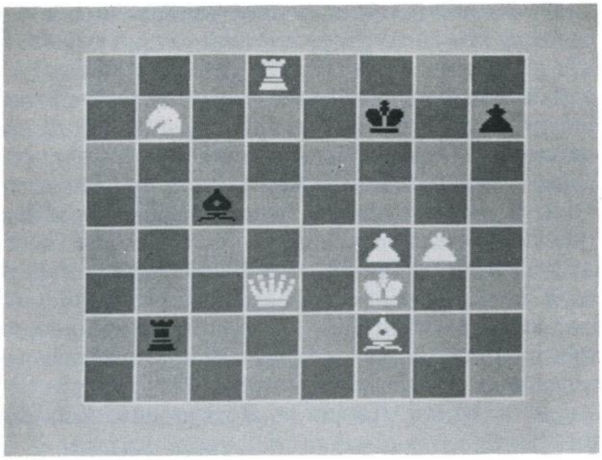


Fig. 5. Chessboard and pieces to show the use of programmable characters at Level 4 (770 bytes required for transmission).

Animation

The potential of teletext as an animation medium has already been explored in Level 1 by the ingenious use of flashing control codes. At Level 4, it is possible to exploit this potential still further and two particular forms of animation have so far been investigated.

The first of these forms appears most suitable for educational displays, in which either textual or graphic information is added or erased at intervals determined by delay instructions incorporated into the program. This allows the user sufficient time to absorb one set of information before proceeding to the next. The interrupted build-up of a diagram can be instructive as well as entertaining.

The second type of animation uses the conventional techniques of displaying sequentially modified images to create an illusion of movement. This requires two similar pixel plane memories, each of which is alternately displayed while the other is being updated. The procedure works quite well for simple line drawings, but leads to rather jerky motion when microprocessor speed visibly limits the rate at which large areas of colour can be refreshed.

CONCLUSIONS

The IBA proposals for Level 4 enhancements to British teletext have compatibility and efficiency as their principal features. It is intended that a future Level 4 receiver designed on these principles should be capable of correctly presenting all the lower teletext levels and of allowing mixed displays, in which a more detailed diagram is substituted for a coarser lower-level mosaic.

Comparisons of the coding transmitted for existing Level 4 pictures with theoretical estimates for identical displays produced in accordance with alternative proposals such as Telidon and the AT & T specification, show data savings of between 10% and 60%, even before an allowance is made to accommodate presentation level protocols (PLP).

The implementation of a hardware 'rounding' algorithm significantly improves the appearance of characters and irregular lines, when compared with those of other alpha-geometric systems, which, as far as is known, do not include such a feature.

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The Networking of ORACLE

by G. A. Johnson and J. N. Slater

GEORGE JOHNSON B.Sc., C.Eng., MIEE on graduating from Queen Mary College, London, joined the BBC. On completion of a Graduate Apprenticeship, he joined the Planning and Installation Department (becoming later the Studio Capital Projects Department) where he was responsible for projects in the fields of television recording and television studios. In 1978 he joined the Independent Television Companies Association (ITCA) as the assistant to its Co-ordinating Engineer, acting as secretary to several ITCA committees and working groups. In 1982 he was made responsible for the detailed planning and the commissioning of a new ORACLE teletext centre located in Central London. He is a member of the Royal Television Society and has an amateur interest in philology.

JIM SLATER, T.Eng. (CEI), AMIERE was educated at North Manchester Grammar School and University College, London. He spent eight years working in transmitter operations and maintenance at the BBC before moving to the BBC External Services headquarters, a job which took him to various parts of the world. After some time in BBC Engineering Information Department, he joined the IBA's Engineering Information Service in 1976.

He has been involved with teletext since its earliest days, when he took prototype equipment to manufacturers for discussions about the practicability of making dedicated integrated circuits. He investigated teletext reception problems and has lectured widely on all aspects of the subject. He has given many lecture presentations on the IBA's work on enhanced graphics and telesoftware.

Synopsis

The teletext service for Independent Television (known as ORACLE) is provided by Oracle Teletext Ltd. The development of the ORACLE service is described in detail—from its early beginnings as an experimental service in the London area to a service available nationally on both the Independent Television (ITV) and Fourth Channel networks.

For purposes of signal distribution, the ITV and Fourth Channel networks are considered in two parts, firstly, the network of lines and microwave links rented from British Telecom (BT) that take television signals from studio centres to the main transmitters and, secondly, the re-broadcast network of UHF transmitters and transposers which ensure that UHF television signals reach even the remotest parts of the UK.

The coming of breakfast television (TV-am), Channel 4 and Sianel Pedwar Cymru (the fourth channel in Wales) has further complicated the networking arrangements required to ensure the nationwide distribution of teletext signals. In addition, some ITV programme contractors are adding their own regional ORACLE magazines to the nationally networked service.

EARLY DAYS

Following the development of the ORACLE teletext system by IBA engineers in 1972 arrangements were made for the IBA to produce and transmit experimental ORACLE pages on ITV in the London area. Teletext data streams representing these pages were added to the otherwise blank lines 17 and 18 (330 and 331) of the video signal at the IBA Crystal Palace transmitter.

During 1975 the IBA passed responsibility for technical development of the origination equipment (and for editorial preparation) to the ITV programme companies. They decided that the Independent Television Companies Association (ITCA) should be responsible for setting up two origination centres to provide a regular experimental service. One of these units was to provide pages of general information and the other to provide national and international news pages. The news unit was naturally located at the studios of Independent Television News (ITN) which is jointly owned by the ITV programme companies and which was given editorial responsibility for the ORACLE news pages. The other unit was located at the South Bank studios of London Weekend Television (LWT).[1]

ITCA specified the operational requirements for the computer-based system; the computer-to-television signal interface was based on an ITCA design. The computer software allowed up to eight magazines to be produced, each of up to 100 pages of text and simple graphics, which could be transmitted on up to 16 lines of each television field-blanking period. Constraints elsewhere in the television system did not allow full advantage to be taken of all the features provided by the software of the experimental system. However, features such as newsflash and subtitle pages as well as multipage working (where pages are automatically changed in content after a period previously set by the editor), were employed.

The distribution of ORACLE Teletext signals on the ITV network created some problems in the early days. The problems were not entirely of a strictly technical nature. The high-quality programme links 90% of which are rented by the IBA from British Telecom (BT), and 10% of which are provided by IBA, for the transmission of ITV programmes were very quickly proved capable of transmitting teletext data with negligible degradation over even the longest paths, though the links had never been specified with the intention that they might be expected to carry data at 6.9375 Mbit/s. The difficulties that did arise occurred primarily because this distribution network had been specifically configured to meet the flexible needs of routing the television and sound signals. The fifteen ITV programme companies together with Independent Television News (ITN) need to be connected together in such a way that television programmes can be fed from any one of the companies to any combination of the others; the exact configuration of the network changes many times during each day (see, for example, Figs. 1 and 2). For distribution of teletext signals a link from the teletext origination centres in London is required to feed all regions simultaneously throughout all broadcasting hours.

It was not considered economically viable or indeed necessary to provide either a completely separate set of vision circuits or cheaper lower-

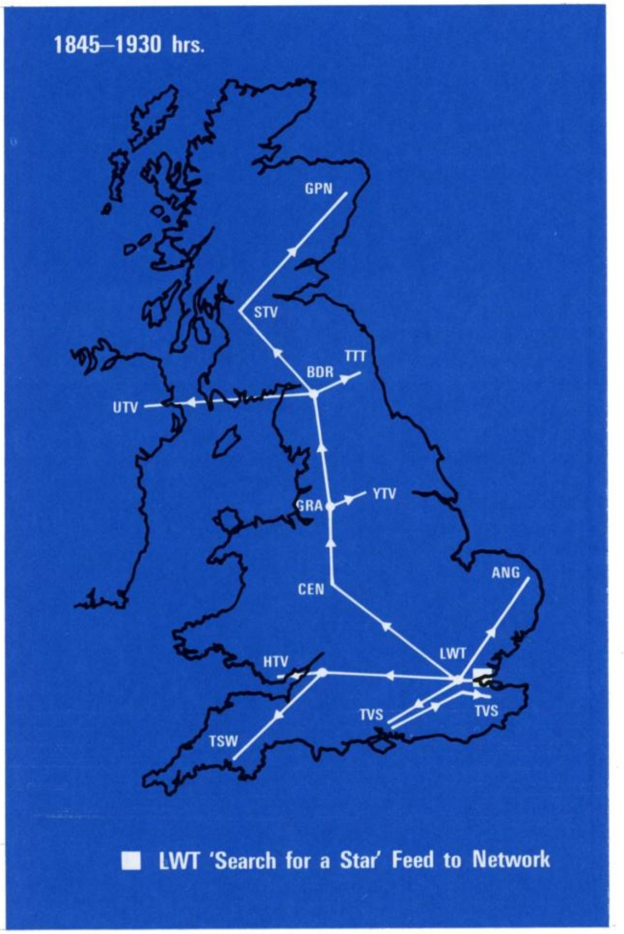

Fig. 1. An example of the London ITV contractor feeding the entire ITV network. In this case, the ORACLE service being originated in London would be available in all regions.

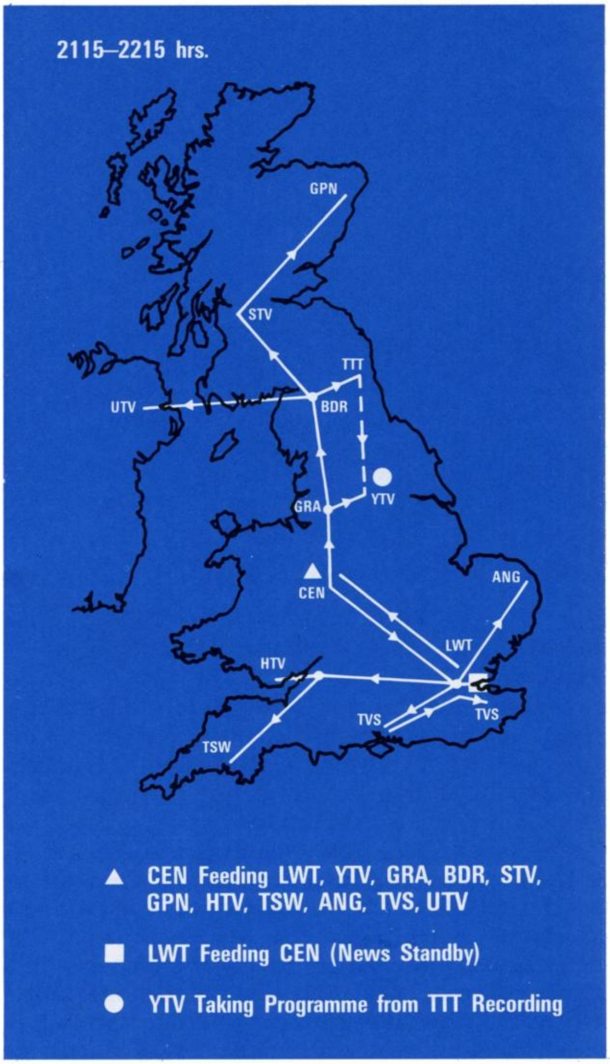

Fig. 2. When regional programme contractors are originating their own programmes, or are receiving network feeds other than from London, ORACLE data would not be available unless special arrangements were made.

bandwidth data circuits to distribute teletext signals, since one of the major features of teletext is that it can travel as an integral part of the normal television picture information.

Although for some parts of the day the UKIBA network is configured in a 'star' form, with programmes from London radiating out to all regions, for much of the time there are some regions with no direct network connection to London. Special arrangements are needed to ensure continuous teletext in all regions at all times.

During the early days of the ITCA operation, the ORACLE signal was added to the transmitter and network video output circuits of the (London) 'nominated contractor' (Thames Television during weekdays and LWT at weekends). The ORACLE data was injected by field-blanking interval inserters (which are referred to as 'inserters' later in this article) which had been provided already by the IBA in all programme company main outgoing video circuits for the purpose of adding Insertion Test Signals (ITS). The teletext data must be synchronous with the outgoing video signals and so it was arranged that the mixed sync pulse feed, which controlled the timing of the data leaving the computer/television interface, was derived from the outgoing video signal. By this means the ORACLE service was radiated in the London area and also in the area of any programme company which was simultaneously broadcasting material from the nominated contractor. However, when a regional ITV company was originating its own programme or commercials, or was taking a programme from a source other than the nominated contractor, it lost its ability to pass on ORACLE data.

The Data-Bridge: a Requirement for Networking

In September 1975, the Royal Television Society's Convention was held in Cambridge (in the reception area of the IBA's Sandy Heath transmitter, radiating Anglia Television programmes). In order that an uninterrupted full ORACLE service could be provided at the Convention, engineers from Anglia and ITCA specially designed an equipment which was installed at Anglia Televison. A network video feed from the nominated contractor was connected to the input of the equipment. ORACLE data was stripped from the video signal and stored in a Random Access Memory (RAM). The design allowed the data to be read out of RAM at a rate and time determined by an external mixed sync signal. In the Anglia installation this mixed signal was provided by the ITS inserter which was installed in the transmitter video output path. The output data was by this means synchronised and appropriately timed to the station's video output signal. In simple terms, the data was 'bridged' between the incoming and the outgoing circuits irrespective of the programme material being put out by Anglia. This pioneering 'data-bridge' formed the basis for commercially-developed units which were subsequently purchased by ITCA and installed over the next few years at strategic parts of the ITV network. By this means the

ORACLE signal could be distributed to all programme companies irrespective of the configuration of the network for television programme interchange purposes. Some features of the data-bridge design were later to be incorporated in teletext data regenerators.

Towards the end of the experimental period the Government gave approval for a permanent teletext service. A data-bridge was installed at ITN which permitted the output of the ITN computer to be added to the ITN video signal (previously the ITN computer had been connected by data links to the LWT computer); extra keyboard positions were provided at ITN and LWT and there was continued experimentation with new facilities. These included the world's first transmissions of teletext telesoftware by ORACLE in 1977, Level 2 'Parallel Attributes' in March 1980, and in 1980 demonstrations (in co-operation with British Telecom Research) of full-colour Level 5 'Picture-ORACLE' pages. During this time more data-bridges were installed at programme company premises to allow data to be transferred to secondary video output paths and to circuits introduced by the expansion of the UKIBA permanent vision network.

A particular problem occurred when the South of England contractor (originally Southern Television and later TVS) used the single video network circuit into its Southampton studios at certain times of the day to take material from a studio centre in the east of its region. At these times it lost the network ORACLE signal (see Fig. 3). The problem was solved after successful negotiations between the IBA and British Telecom (BT). BT agreed that ITCA data-bridge and data insertion equipment could be installed at its London Network Switching Centre (NSC). The equipment allowed national data to be taken from the ITN output video signal and to be inserted into whichever signal was being sent via the video circuit to Southampton (see Fig. 4).

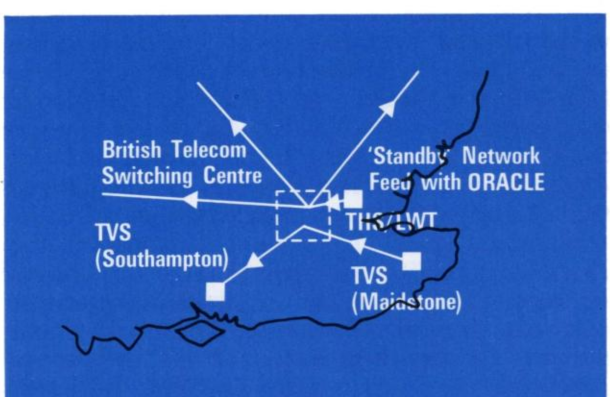

Fig. 3. When the incoming network feed to TVS in Southampton was connected to its Maidstone studio, it lost the ORACLE feed from the London 'nominated contractor' (prior to the installation of a data-bridge at the London BT Network Switching Centre).

Oracle Teletext Ltd

Each ITV programme company holds a franchise awarded by the IBA to provide programmes and a teletext service in its area. In the autumn of 1980, the Council of ITCA decided to form Oracle Teletext Ltd from the existing ORACLE units with the involvement of the former ITCA ORACLE Management Committee. Through the ITCA Council the ITV programme companies appointed Oracle Teletext Ltd to provide the teletext service on their behalf.

More Data Lines Make Regional ORACLE Practicable

1981 was the first of two hectic years of ORACLE system development. Computing power was increased at both LWT and ITN, this increase reflecting the additional information being provided by the ORACLE service. A Sales and Marketing team was recruited in the summer of 1981 following Government and IBA approval for the commercial use of the ORACLE service by the inclusion of advertising pages. Terminal equipment for the preparation of advertising pages was added to the system and more use was made of an existing teletext graphics interface unit. At about this time, there were three further major developments. One of these was the decision to double the number of field-interval blanking lines used to carry data. This followed the results of a comprehensive survey by ITCA of the possible adverse effects of extra data lines on normal television reception.[2] Another development was the decision to set up regional ORACLE units. These would supplement the news and national information service received from London by the addition of a regional magazine of up to 100 pages of local news and information carried by data occupying one of the additional field-blanking lines. The first regular regional teletext service in the world to supplement a national service in this way was provided by new equipment and an editorial team at Scottish Television's Cowcaddens studios in Glasgow in

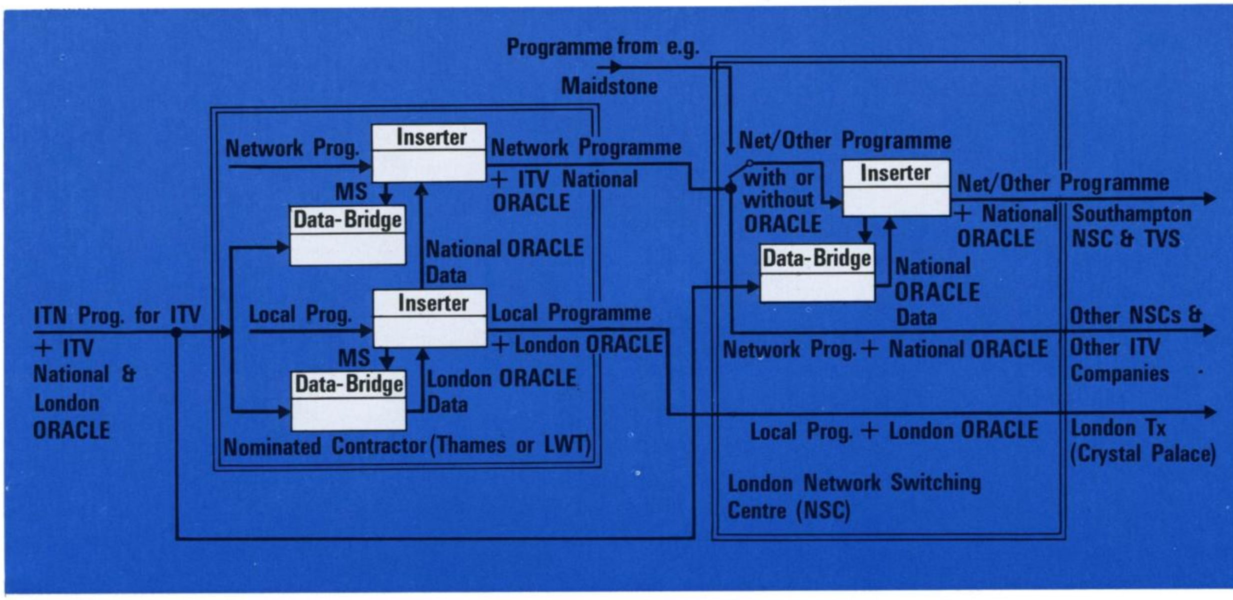

Fig. 4. ORACLE distribution in London for ITV.

October 1981. The second regional service was set up in February 1982 at Channel Television's studio centre in St. Helier, Jersey and the third in November 1982 in London. The third development followed the decision that the ORACLE general information unit should be transferred from LWT premises to a custom-built teletext centre in Central London, close to ITN and ITCA headquarters.

The engineering problem of combining the networked and locally-originated regional magazines had been under consideration for some time. The simplest solution was chosen whereby the ORACLE service is transmitted in what is termed the 'magazine parallel' mode. Currently this arrangement is implemented on the ITV network by transmitting magazine 3 on lines 15/328. The three regional units each produce a magazine 3 for their local ORACLE services. In these areas a data-bridge passes data for magazine 1 on lines 16/329, and for magazine 2 on 17/330 and 18/331 to the IBA inserter in the station's transmitter video output path (thereby ignoring the incoming magazine 3 on line 15/328 and replacing it by the local magazine 3 which is added to video signal via the same inserter). This is shown in Fig. 5. The arrangements at a programme company which does not originate its own ORACLE service are shown in Fig. 6. It will be seen that national ORACLE data is always present on the inter-company video network.

A New Teletext Centre: General Information Services for ITV and the Fourth Channel

The new ORACLE centre was brought into action in January 1982, initially with a temporary installation and later with a computer system which is more powerful than that employed at LWT. Later in the year, agreements were made for Oracle Teletext Ltd to provide teletext services for the new fourth channel networks Channel 4 (Ch.4) and Sianel Pedwar Cymru (S4C). To supplement this agreement a separate computer was installed at the centre to allow three magazines (currently, magazines 4, 5 and 7) of general information for the Ch.4/S4C network to be formed from certain pages prepared by the main computer system. The main computer also provides three magazines for ITV. Currently these three magazines comprise numbers 1, 3 (for London) and 3 (for the network). A simple data adder allows these ITV and Ch.4 magazines to be carried together on a video signal which is fed to ITN where a system of data-bridges, data adders and inserters reject certain data lines and accept others in such a way that the magazines intended for ITV are added[3] to ITN's magazine 2 and then passed on to the London NSC and to the (London) nominated contractor. Since 1st February 1983, the ITV magazines have similarly been passed on to TV-am, the early morning national 'breakfast television' programme company. In the

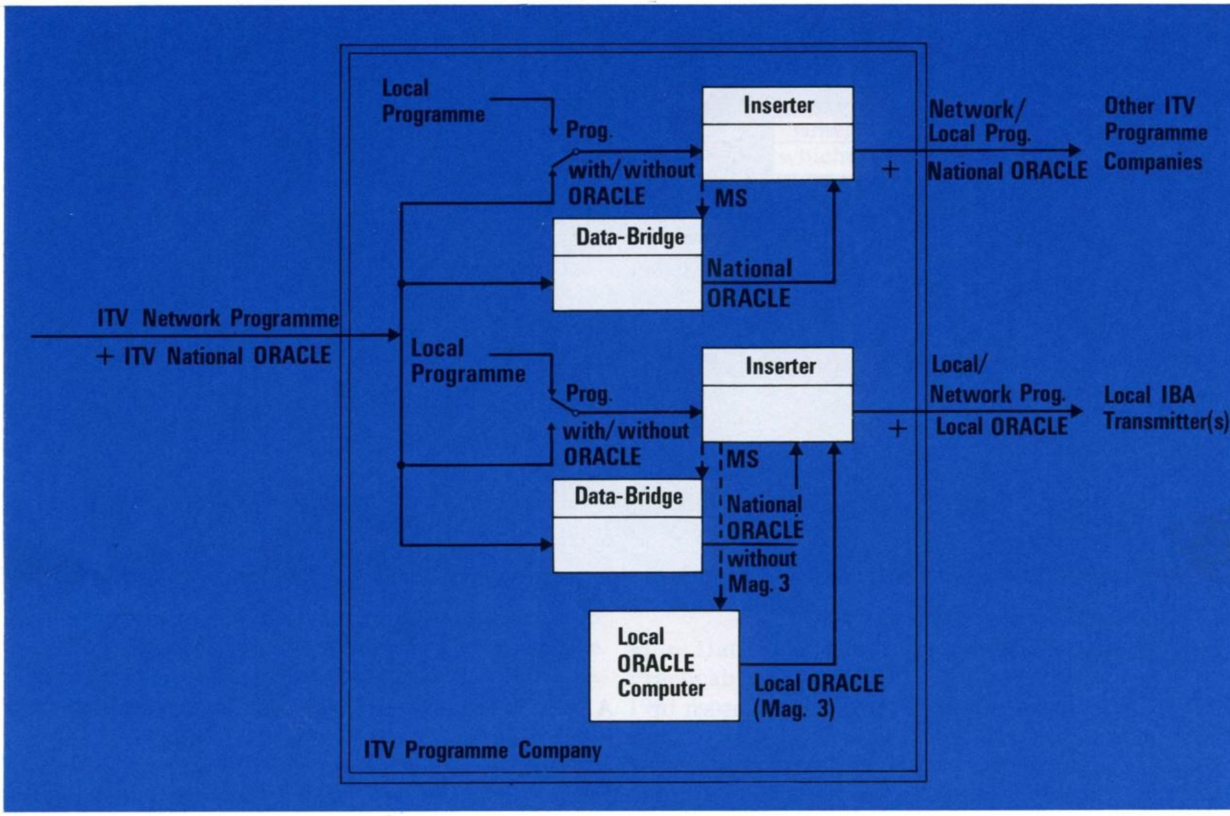

Fig. 5. ORACLE routing at an ITV programme company which originates its own regional ORACLE magazine.

same way, the magazines intended for Ch.4 and S4C are added to ITN's magazine 6 and are passed on to Channel 4's nearby premises. Fig. 7 shows the routing arrangements between the ORACLE teletext centre and ITN and the data paths within ITN.

Distribution of ORACLE on the ITV Network During Breakfast Television

The early-morning breakfast-time television programmes from TV-am are originated in London, and are radiated from all ITV transmitters without passing through the studios of any other programme company. This means that after closedown of the normal ITV late-night programmes the network has to be re-arranged by British Telecom in a special breakfast-TV configuration. This switching takes place at 05.40 and the network reverts to normal shortly after the end of breakfast television so as to by ready for the start of regional ITV programming from the various contractors at 09.30.

Although TV-am programmes are distributed nationally, separate advertisements can be inserted for each of seven 'macro regions'. These 'macro regions' are London with South and South-East England and East of England, East and West Midlands, Wales and West of England, North-West England, North-East England, Scotland, and Northern Ireland. Data-bridges are therefore needed at TV-am's premises for each of the advertisement areas to ensure continuity of the networked ORACLE data.

The signal to the nominated contractor and to TV-am carries two versions of magazine 3 (the local version is on line 14/327 while the national version is on 15/328). As shown in Figs. 4 and 8, data-bridges at these destinations are employed first to separate the local and national versions of magazine 3 from line 14/327 and line 15/328. At the nominated contractor's premises, the transmitter output is provided with magazines 1, 2 and 3 (London) and the network output with magazines 1, 2 and 3 (National).

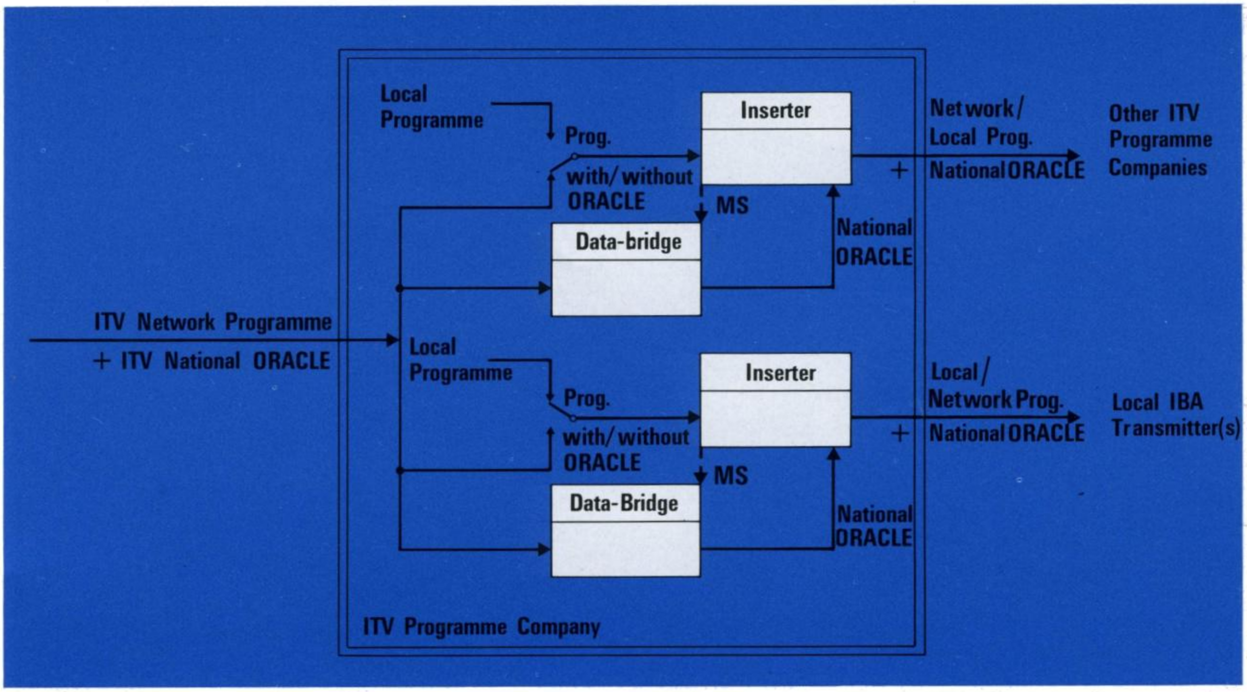

Fig. 6. ORACLE routing at an ITV programme company which does not originate its own ORACLE service.

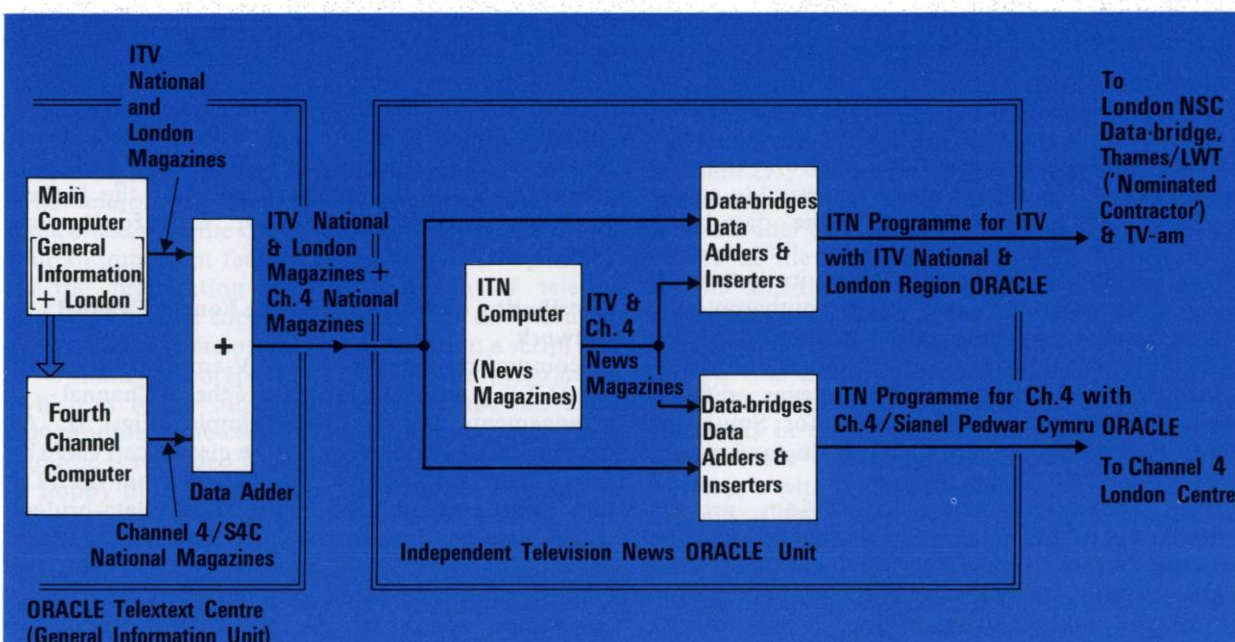

Fig. 7. ORACLE origination (National and London magazines).

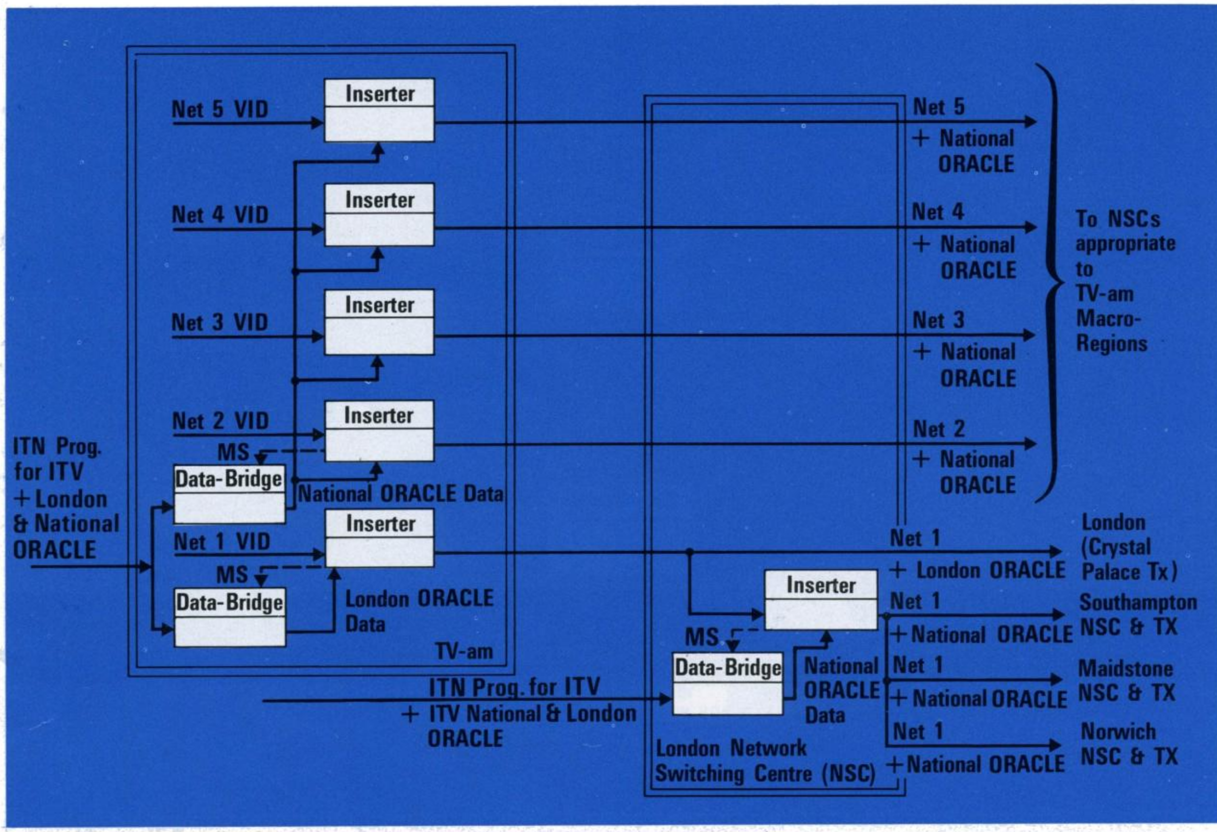

Fig. 8. ORACLE distribution in London for TV-am.

TV-am's network 1 output carries magazines 1, 2 and 3 (London). This is routed at the London NSC to the IBA Crystal Palace transmitter and also to the video input of the ITCA-owned inserter referred to earlier. It should be remembered that the data-bridge connected to this inserter ensures that *network* ORACLE data is always present at its output. As before, one inserter output feeds Southampton; a second feed of this same output is routed by BT to Norwich and Maidstone for the duration of TV-am's transmission. By these selective means, different parts of TV-am's 'macro region' for South and South-East England and East of England receive appropriate ORACLE magazines.

The second data-bridge at TV-am provides national ORACLE data which is added to all other network output circuits serving the other 'macro regions'. At the BT Kirk O'Shotts NSC (sited south of Glasgow) an ITCA data-bridge has been installed to ensure that the STV local ORACLE magazine 3 replaces national magazine 3 from the TV-am network signal, and appropriate arrangements have since been made to ensure that ORACLE data is also present at those times when TV-am is playing out commercials for the northern parts of the United Kingdom from its studio at Knutsford, near Manchester.

Distribution of ORACLE on the Fourth Channel Network

In comparison with the ITV/TV-am distribution of ORACLE just described, the Channel 4 arrangements are relatively simple (Fig. 9). At Channel 4's London Centre, the circuit carrying the four Channel 4 ORACLE magazines from the ITN data combining equipment is fed to two data-bridges which pass the data to the Ch.4 main and standby outgoing circuits to the London NSC. There, the Ch.4 signal is distributed to the London programme companies and also, via NSCs throughout the country, to the Ch.4 transmitter network via all the other ITV programme companies on the British

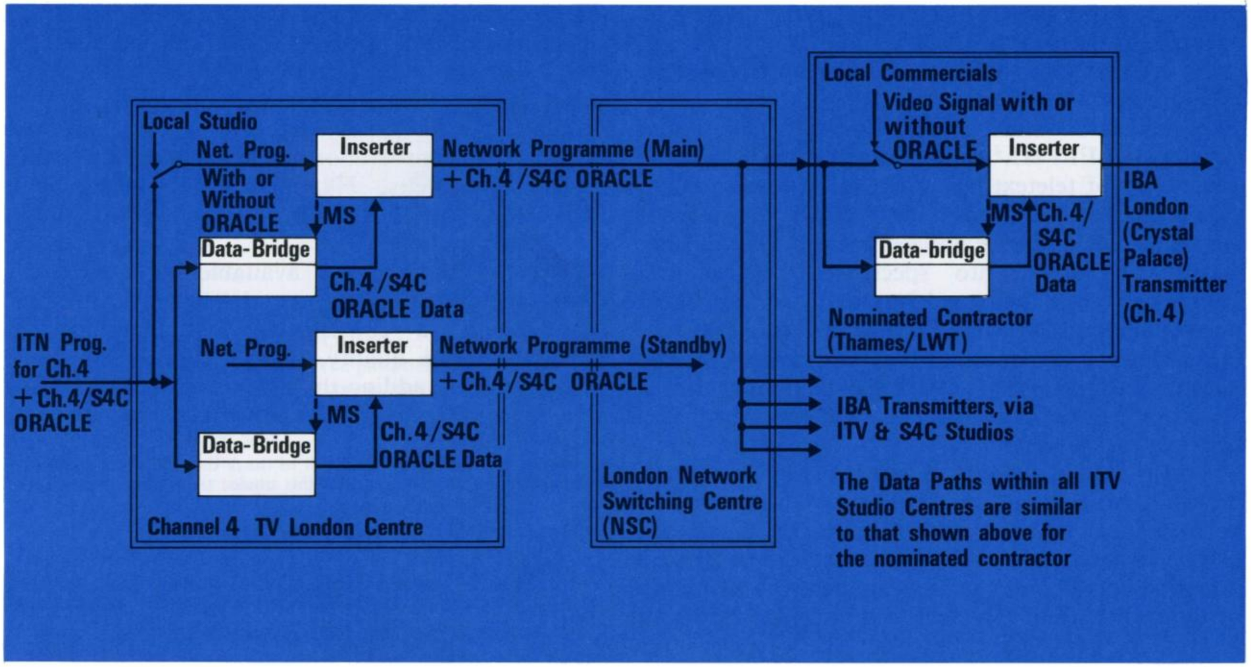

Fig. 9. ORACLE distribution for Channel 4 and Sianel Pedwar Cymru.

mainland and Northern Ireland. At each of these programme company locations, data from the incoming Ch.4 circuit is bridged to feed the outgoing Ch.4 circuit routed to the local IBA transmitters. Similar arrangements apply at the Cardiff centre of S4C where the incoming Ch.4 data is bridged to the S4C output signal.

Video Signals into the ORACLE Centre

The major part of ORACLE's networking is concerned with the distribution of the teletext signal, but an important feature of the ORACLE operation is the preparation and transmission of teletext subtitles (closed captions) for the deaf and hard-of-hearing. These are usually prepared from a script and a U-matic videotape recording of the programme which is to be subtitled. The videotape has EBU longitudinal time-code recorded on one track. Each subtitle is recorded with its appropriate time-code on a floppy disc. At transmission time the programme being networked (e.g. *Coronation Street* from Granada Television in Manchester) is also fed into the ORACLE teletext centre. For *Coronation Street* a vertical interval time-code (VITC) signal is added to the video signal in Manchester. ORACLE compares the VITC signal with the time-codes recorded on the floppy disc and when the time-codes are matched the appropriate subtitle is transmitted as an ORACLE page.

ORACLE ON THE UHF TELEVISION TRANSMITTER NETWORK

In addition to the problems of network distribution were the implications of carrying teletext data over the IBA's UHF television network of hundreds of transmitters, most of which transpose and re-broadcast a signal which has been received off-air from another station. Theoretical studies in 1974 had looked at the security of coding of the ORACLE system[4] and these suggested that the digital teletext signal could be handled by the existing analogue transmission network without difficulty; the early teletext transmissions showed that this was broadly true. It soon became evident, however, that variations in the quality of the transmitted teletext signals were occurring in different parts of the country, with some transmitter performance differences. An extensive series of field trials of teletext reception was conducted from 1976–78[5] in order to quantify these effects.

Initially, subjective tests of off-air decoding were carried out; reception was considered satisfactory if less than eight character errors or omissions appeared on first acquisition of a page. This character error

rate corresponds to a data error rate of approximately 1 bit in 10^3.

In order to be able to obtain more objective measurements of teletext reception, the IBA's Experimental and Development department developed DELPHI,[6] a precision equipment for the generation of teletext test signals of known quality, and data measuring equipment DME[7] which gave very accurate and repeatable measurements of data quality. Research into specialised teletext test equipment continued and resulted in the IBA's development of NEMESIS, a sophisticated teletext measuring and monitoring equipment which automatically analyses teletext signals on any chosen television line, allowing detailed scrutiny and accurate measurements.[8]

It was established that the existing broadcast network was generally capable of a high standard of performance without modification or significant extra maintenance effort, apart from special attention being given to the group delay performance of the transmitters. The tests did however show that it would be beneficial to introduce data regenerators at certain critical points. Such regenerators are capable of correcting for various deficiencies, including:

(i) Quadrature distortion caused by envelope detection in the re-broadcast receiver.
(ii) Noise introduced by the re-broadcast receiver.
(iii) Distortion caused by selective fading affecting the signal incoming to the transmitting station.
(iv) Group delay errors in the parent transmitter.

Since that time, data regenerators have been installed at ten transmitting stations, most of these being re-broadcast stations using envelope detection: Angus, Craigkelly, Hannington, Keelylang Hill, Midhurst, Oxford, Redruth, Sandy Heath, Selkirk, and Sudbury,

ORACLE is currently available over the entire Independent Television and Fourth Channel networks to a consistently high standard of transmitted data quality. Already some programme contractors are adding their own regional ORACLE magazines to the nationally networked service.

Acknowledgement: The authors wish to thank the IBA Lines Section for their assistance in the preparation of this article.

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Equipment for Network Distribution

by P. L. Mothersole

PETER L. MOTHERSOLE joined Mullard Research Laboratories at Salfords in 1953, and became leader of the Video Signal Processing section of the television group. There he was concerned with colour systems development and the use of semi-conductors in television. When the central application laboratory was formed at Mitcham in 1964, he was appointed Senior Group Leader, responsible for the television, radio and domestic appliance activity.

In 1969, he joined Pye TVT as Engineering Manager, and became a member of the executive management team. In 1972 he rejoined Mullard as Commercial Chief Engineer, with responsibility for new products and technologies resulting from research and application studies. He represented the Philips group on the Teletext Systems Committee, which established the parameters of the UK system that has been in use since 1974.

In 1976, he joined VG Instruments Group as Managing Director of VG Electronics Ltd. This company produces the specialist electronic equipment for the Group, and is now a leading manufacturer of teletext and videotex origination and measuring equipment.

Synopsis

Teletext data signals are carried in the vertical blanking period of the television signal. The data is independent of the video signal, but the data signal is vulnerable to group delay distortion, which can occur with some types of network distribution systems, particularly when radio links form part of the chain.

Data-bridges are used to link the teletext signal to other asynchronous video networks and the data is regenerated at the output, as part of the bridging process. Data regenerators can also be used to restore distorted data, independent of the video signal. These units must provide full specification data output signals in spite of any distortion of the input data.

The teletext signal can be generated centrally and supplied to a number of independent networks as required, independent of the video programme material by using data-bridges. Complex and widespread television networks can therefore be used to carry teletext signals and the effects of distortion on the data signal removed where necessary, by regeneration. The transmitted teletext signal can therefore always be maintained to full broadcast specification, independent of the video signal.

The teletext signal is only present on a few lines of the vertical blanking period and the data is constantly changing. Techniques are described to enable accurate measurements to be made of the teletext data signal quality in distribution networks, by both manual and automatic means. Special test facilities are also described for checking the performance of data-bridges and regenerators which have to operate with distorted input signals.

INTRODUCTION

The teletext data signal parameters have been chosen and specified to enable the data to be inserted in the vertical blanking period of a normal television signal, without disturbing the normal vision and sound signals. The data clock rate (6.9375 Mbit/s) is nominally 444 times the horizontal frequency, but the data signal is not locked to the video signal on which it is carried. The data is shaped to be skew symmetrical about half the bit rate and to be substantially zero in amplitude by 5 MHz. The data signal, consisting of high speed pulses, is sensitive to amplitude, group delay and non-linear distortion. Such distortion causes overshoots and a deterioration in the separation between 'O' and '1' levels of the signal.

When a television signal is fed into a widespread distribution network, it passes through various links and switching centres. Although the quality of the colour television signal is maintained to broadcast standards, the data signal can suffer some degradation. To provide the maximum teletext service area and to ensure the data signal does not disturb the reception of normal television sound or vision signals, it is essential that the data signal be radiated without degrading the pulse shape and that the amplitude is at its correct value.

The digital signal can be processed independently of the video signal. This enables the data to be regenerated or linked to other networks as required for the teletext service, without disturbing the normal television network.

TELEVISION NETWORKING

Data-Bridging

Television networks have many special arrangements for distributing video signals which can vary during the day depending on where programmes are originated and which transmitters are to radiate them. For example, the Independent Television network is complicated by the need to have a full regional broadcasting system and, at the same time, allow any one of the fifteen regional programme companies to export their programmes to other parts of the network.[1,2]

The teletext data signal is generated centrally but must be fed to all the transmitters in the network. The data signal can be transferred between networks using a data-bridge. The data from the input video signal is stored in a buffer memory and read out under the control of the regional signal (Fig. 1). The two video signals can be asynchronous and the video lines on which the data is carried need not be the same. The data is re-timed, pulse shaped, and the video line erased prior to insertion to ensure the highest possible quality of the teletext signal. A teletext signal can therefore be passed through very complex video television networks or can be by-passed from studio centres as required, without any disturbance to the normal television operation.

The data-bridge is designed to incorporate a test page generator which is initiated whenever no data signal is received from the input network. The page can be programmed to contain an apology caption and also provide test signals at all times for the use of technicians installing or maintaining teletext-equipped television receivers.

The data-bridge also contains facilities for shifting the television lines on which the teletext signal is

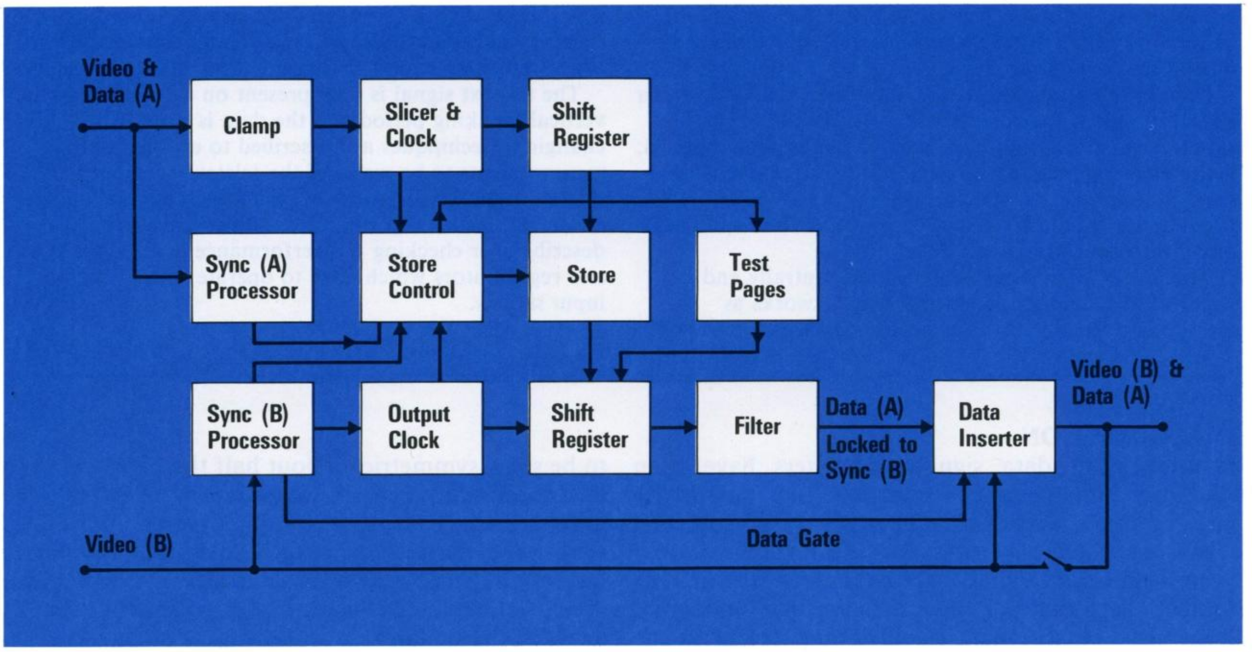

Fig. 1. Inserting Data-Bridge.

carried. This facility enables various teletext sources to be combined on to one video signal for distribution purposes. This technique is particularly useful when a satellite distribution system is used to feed a number of different networks or cable operators. It enables one satellite signal to carry a number of independent teletext channels, which can be selected by different networks or operators.

Regional Services

The data-bridge enables a teletext signal to be linked from a central distribution network to a separate regional network, but often local pages of information require to be inserted for regional use. This can be achieved in several ways. The simplest is to use an additional television line for the local magazine and to use a unique magazine number to prevent interaction with the magazines carried on other lines. When only fifty to a hundred or so pages are being used for the regional service, only one data line is required to provide a reasonably short access time.

When four data lines are available, the teletext magazines from the main network can be carried on, say, two or three data lines with the local station inserting the regional magazine on to the fourth data line. Teletext decoders respond to data in any of the 16 data lines in the field blanking period and therefore the only limitation to the number of data lines used is the broadcasting control authority.

To combine pages of data from a main network into the magazine of a regional system requires a much more complex arrangement. The required pages from the main network need to be selected by a programmed decoder and the serial data, after error checking, entered into the magazine of the regional station for transmission. The local system can accept the pages without manual intervention, provided the programmed decoder allocates the local magazine and page number to the selected pages.

Low-frequency telecommunications modem links can also be used to update regional or international teletext services when no direct video feed is available. Pages can be inserted directly into the magazine of the remote system, or via an editing terminal if manual supervision is required.

Data Regeneration

The transmission of television signals in widespread networks inevitably causes some distortion to occur. The specifications for video links and associated measurement techniques are designed to meet the needs of the television signal to ensure it meets broadcast standards. Different criteria may apply to the requirements of fast data signals which are particularly sensitive to group delay and the non-linear distortion of some rebroadcast links (RBL).

Provided the teletext data can be decoded correctly, its characteristics can be fully restored by regeneration. At the present time, regeneration of the data signal must be carried out at video. Regenerators can therefore be used only where the baseband signal is available, such as at the input to a transmitter.

The regenerator strips the data from the video signal, completely reprocesses and re-times it, carries out band-shaping, and then re-inserts the data onto the video signal one field period later, after erasing the video lines prior to insertion. The video inserter section of the regenerator must meet the full colour television broadcast specification as it is in the main programme path, and it must also be equipped with a physical by-pass relay in the event of a malfunction.

In addition to their use at transmitting sites, regenerators are also necessary at the outputs of videotape machines to restore the teletext data when subtitles are recorded as part of the programme material.

Data regenerators cannot be used at transposer stations because the vision signal is converted only to an intermediate frequency and not to baseband. Current transposer designs are broadband to accommodate combined sound and vision signals and, since they have no sound notches, they do not introduce significant group delay errors at high video frequencies. The requirement for regeneration equipment in transmission chains incorporating transposers is therefore much less, as the data signal degradation is smaller.

Measurement of Teletext Signal Quality

The teletext data signal contained in the vertical blanking interval is very difficult to measure accurately using a normal oscilloscope, particularly as the data is not locked to the video signal. To examine the data, the oscilloscope timebase must be triggered from the data clock run-in at the start of the data line, but this requires a special trigger circuit sensitive only to the 6.9 MHz clock frequency.

The teletext signal is generated by passing the fast digital bit-stream, which has identical rise and fall times, through a special band-shaping filter. Degradation of this signal by noise, reflections, non-linear amplitude and group delay all contribute to a

loss of the decoding margin; that is, the difference in level between the '0' and '1' in the bit-stream. The principal and most critical parameter of a teletext signal is the decoding margin, and this is the prime criterion for teletext signal quality.

A Lissajous figure may be displayed on an oscilloscope (see Fig. 2) by applying the data to the vertical deflection amplifier and using a sub-multiple of the data clock for the horizontal deflection (usually quarter clock frequency). A data line bright-up pulse is also necessary to exclude all television information.

The resulting display resembles an 'eye' and the difference between '0' and '1' levels is referred to as 'eye height'. The eye opening is normally expressed as a percentage of the true data amplitude. As the data signal is degraded, the eye height falls until in the limit decoding is virtually impossible.

The Lissajous figure method of measurement suffers a fundamental disadvantage in that the reference data clock must be extracted from the distorted data stream. Any phase jitter of the reference clock from the data stream will cause phase jitter to the horizontal waveform and falsely reduce the height of the eye diagram. This difficulty increases with low values of eye height when extraction of a jitter-free clock reference becomes more difficult.

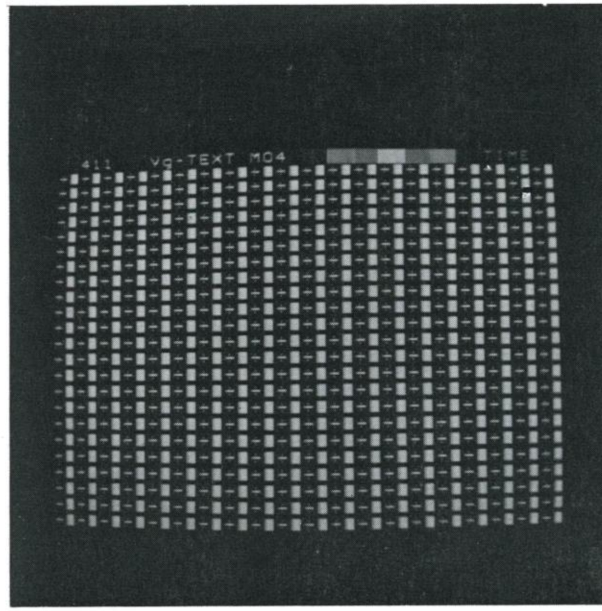

Fig. 3. Clock Cracker Page.

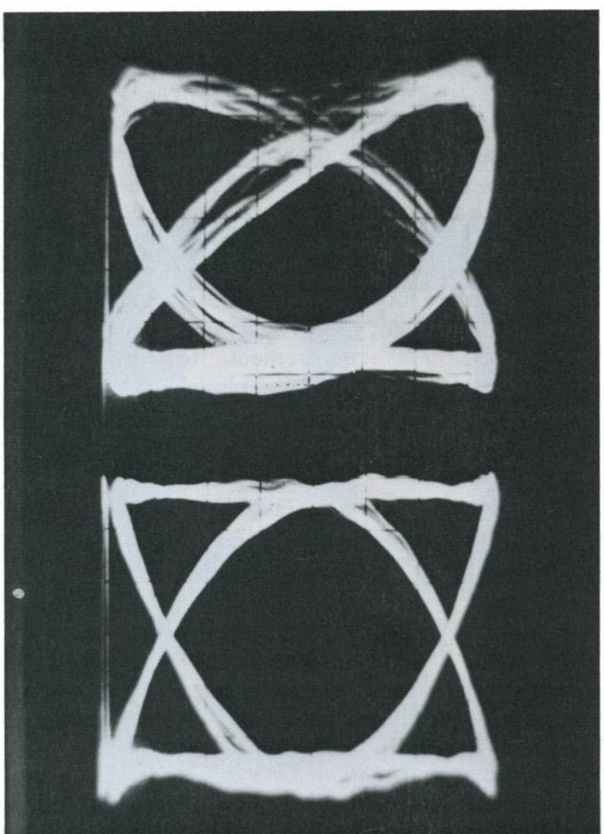

Fig. 2. Eye Displays of Distorted Data.

The data quality may be estimated by direct inspection of the data stream on a normal oscilloscope display of the 'clock cracker' page (Fig. 3). This test page is composed of alternate symbols which have the minimum number of transitions. This page therefore imposes the most searching test of the decoder clock recovery circuits, and also is the least confused bit-stream for visual estimation of eye height or decoding margin. Errors on the displayed page of text are of course very easily seen.

An alternative method of determining signal quality is to measure the effective separation between the worst '0' and '1' levels over many data lines. An instrument specifically designed for this purpose is the Decoding Margin Meter (Fig. 4) which provides a digital display expressed as a percentage of true data amplitude.

The instrument is automatic in operation and a comparison technique is used so that the measurement is independent of data information or

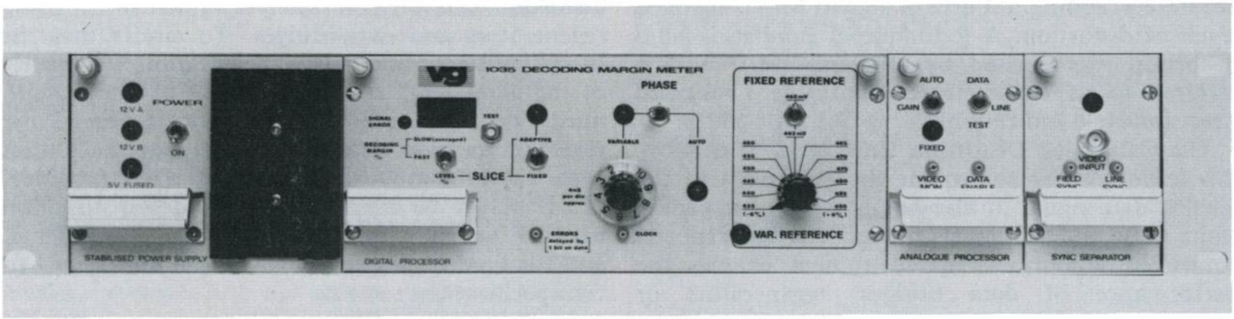

Fig. 4. Decoding Margin Meter.

format. The input signal is automatically controlled to a standard level, using the VITS bar for reference, so that the data amplitude at the input to the measuring system is at its correct value and, therefore, the measure of decoding margin is not dependent on amplitude.

The data signal is applied to three slicing circuits operating in parallel. The output signals from the first and third are compared to the output of the second slicer, which is used for reference purposes and has either a fixed or an adaptive slicing level. The slicing levels of the first and third circuits are progressively changed, positively and negatively, respectively, with respect to the reference slicing level, until a difference signal is generated by the comparators. The difference in potential between the slicing levels is then used for computing the decoding margin and is displayed as a percentage of true data amplitude. The measurement is averaged over 10 or 1000 data lines and hence takes into account the effects of noise and co-channel interference.

The instrument enables consistent monitoring of the data signal quality. An output is provided for remote display or for feeding an automatic data logger, and an alarm signal is generated if data is lost. To assist in detailed analysis of distorted data using an oscilloscope, a bright-up pulse is generated corresponding to the worst '0' and '1' in the bit-stream.

Data-bridges, regenerators and decoders are required to operate reliably with distorted input signals. To measure and assess the performance

Fig. 5. Calibrated Distortion Unit.

accurately requires a source of signals with controlled levels of distortion. A technique of simulating echo distortion was devised by IBA engineers[4] and is referred to as DELPHI (Defined Eye Loss with Precision Held Indication).

The Calibrated Distortion Unit, (Fig. 5) employs this technique for controlling the eye height of the teletext data signal. It also has provision for adding white noise and simulated co-channel interference in controlled amounts. This instrument enables the performance of data bridges, regenerators or decoders to be measured and analysed very accurately.

CONCLUSIONS

Teletext data can be generated centrally and distributed over widespread video networks to the transmitters, but it is essential that the transmitted signal fully meets the broadcast specification. Fast data pulses are vulnerable to group delay distortion, but providing the data is capable of being decoded, distortion can be completely eliminated by using regenerators and data-bridges. To ensure that the broadcast signal fully meets specification, the quality of the data signal at various points of the network must be monitored, and data bridges and regenerators must produce immaculate data output even when the input is distorted. The teletext signal can therefore be distributed in a video distribution network virtually independent of the video signal, and the final broadcast signal can be maintained to full specification.

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Integrated Circuits for Receivers

by Staff at the Mullard Application Laboratory

The MULLARD APPLICATION LABORATORY is based at Mitcham, Surrey, and is involved in a variety of activities concerning the specification, design and use of Mullard components. Over 50 graduate engineers are engaged in projects ranging from power control to telecommunications, text handling to domestic appliances.

The text handling group laboratory is responsible for the specification and design of systems and components for teletext and viewdata. In particular, this involves the design and computer simulation of complex VLSI integrated circuits. As the implications of these new systems are so wide-ranging, the group has also a co-ordinating role, and is concerned with such aspects as transmission standards intefacing and future developments. Within the laboratory a group of Market Application engineers are the first line of contact with major customers, giving applications support and problem solving expertise.

Synopsis

The development and volume production of low-cost integrated circuits for teletext reception constituted a critical factor in ensuring the success of teletext as a national broadcast service. About 30% of all new television sets sold in the UK are now teletext models, nearly all of which use Mullard components or modules. To date, Mullard has supplied over three million chip-sets to setmakers in several dozen countries, making it the largest manufacturer of teletext ICs in the world.

Recognising that mass sales would only be made if the equipment required at the consumer end was relatively cheap and very reliable, a consensus was reached among broadcasters and setmakers to opt for a rugged system that would use the synchronism inherent in transmitted TV signals. This system, while offering positive error correction, demanded no advanced microprocessor technology at the receiving end. The choice of this pragmatic, user-orientated approach, to which Mullard then applied its considerable electronics expertise, has made possible the low-cost teletext chip-sets and modules which are described in this chapter.

INTRODUCTION

The Mullard Application Laboratory in Mitcham, Surrey, began development of teletext decoders in 1973, when the experimental transmissions of CEEFAX (BBC) and ORACLE (IBA) were to different technical standards. Decoders for each system were designed and constructed using the technology available at that time, i.e. TTL gates and counters for the main logic, a P-MOS ROM for the character generator and dynamic N-MOS RAM as page memory. The video processing function used discrete transistors.

The experience gained with these units paved the way to a new prototype decoder design covering the unified UK standard (see Fig. 1). This design was developed during 1974 and 1975, and led to the incorporation of several of its design features in the 1976 Broadcast Teletext Specification. The decoder consisted of a dozen printed circuit boards in a rack with a total IC count of around 250. Obviously such a decoder was far too expensive, and too bulky, for the consumer market. To reduce costs, development of dedicated LSI circuits specifically for teletext was begun in 1975.

Within LSI, N-MOS technology offered particular advantages in production and testing which were essential if teletext was to make rapid inroads into the mass consumer market expected of it. N-MOS is also relatively cool in operation, highly reliable and

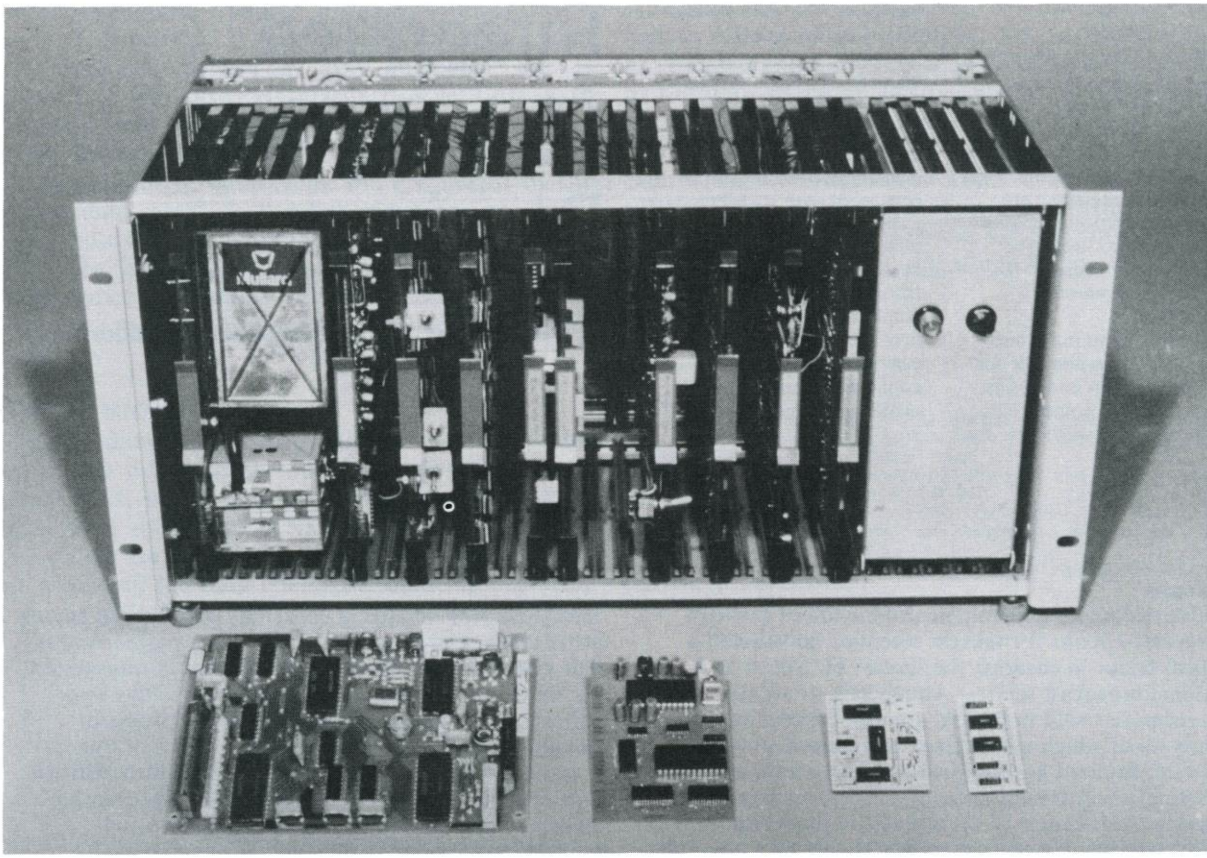

Fig. 1. An early experimental Mullard decoder utilising TTL technology, together with a modular decoder using the basic LSI chip-set. Also shown is an experimental module suing surface-mounted components including SO (Small Outline) miniature Ics on a conventional printed circuit board. Contrasted is a further development—a decoder assembled as a pair of thick film hybrid microcircuits.

economical on current—all key features in making the components and ultimate modules attractive to setmakers.

The consensus among setmakers was that, for the UK at least, teletext decoders should be small enough to be incorporated within the TV cabinet as a single unit for sale or rent. Add-on adaptors would have an important role to play in some markets, notably the US, but not in the UK. (For that reason, the remainder of this chapter addresses itself exclusively to built-in decoding equipment.) Nevertheless, teletext decoders were viewed primarily as optional extensions to a standard TV receiver. It is only in the last few years that decoders have come to be viewed as an integral feature of TV chassis designs.

A particularly critical aspect of the development work involved decisions about the partition of teletext functions across three, four or more potential component ICs. This required a delicate balancing of trade-offs between the advantages of mass-producing many limited-function ICs and the cost/size advantages of combining a maximum number of functions on each chip. This was further complicated by a fast-changing scenario of developing national teletext standards across Europe and beyond, each one requiring certain peculiarities of circuit design to meet its requirements, and in production volumes that were little more than educated guesses.

Eventually, three special N-MOS digital circuits and one linear bipolar circuit were decided upon. Early samples of each were available in 1977 and extensively field tested by customers. Their suggestions guided the evolution of large-scale production circuits which became available in 1978.

It is this decoder design that has been used in the great majority of teletext sets around the world.

The French teletext system, Antiope, uses a different technical approach and a different set of ICs is required. Development started in 1979 on the timing chain and character generator devices for this system, and these were available from 1980. The acquisition function is based on two-gate array circuits.

An important development related to teletext was production of Mullard's 'LUCY' device for wired text (viewdata) systems. The LUCY development programme started in 1978, with first samples available in 1979 and in production volumes in 1980. Using LUCY and a microprocessor, a complete viewdata terminal can be constructed, utilising the teletext character generator and timing chain circuits.

SIGNAL PROCESSING—REMOTE CONTROL

So how does the Mullard teletext chip-set go about performing the necessary signal processing tasks to put broadcast teletext pages onto the user's screen? It is first necessary to view the process from the vantage point of the user—the eventual customer and consumer. To him or her, the processing of teletext signals is only as good as the interface mechanism he has available. In almost every case, that interface is a remote control device, because the number of individual commands needed to utilise teletext to the full makes manual input at the TV receiver itself an uncomfortable and inconvenient method in interaction. Hence, if teletext is to be a success in the marketplace, the signal processing electronics need to offer sophisticated remote control systems as an integral part of their design. At Mullard, this has been achieved with the teletext and viewdata-compatible SAA5000A/SAA5012 and SAB3021/SAB3042 transmitter/receiver systems.

SAA5000A/SAA5012

The SAA5000A/SAA5012 remote control is a powerful yet economical system which may be used for either infrared or ultrasonic transmission. It is based on time-ratio discriminations, avoiding the need for accurate timing components and providing a wide choice of data transmission rates. Protection against interference is provided by the method of data encoding. When a command is entered on the keypad, a 24-bit data stream is transmitted, following a short pseudo-random sequence. This comprises a 7-bit start code and a 5-bit message. This 12-bit sequence is then transmitted again, but inverted; the receiver does not respond until all 24 bits have been received and checked.

The SAA5012 decodes received command data and controls TV receiver functions (analogue and tuner). The five message bits give a maximum of 32 commands but mode selection means that more commands are available. The SAA5012 further acts on these mode bits to re-interpret and transmit commands specifically intended for teletext or viewdata circuits. To avoid confusion, commonly used commands have the same key in all modes.

SAB3021/SAB3042

The SAB3021/SAB3042 remote control using infrared transmission is part of Mullard's more comprehensive Video Tuning System (VTS). This is a range of microcomputer controlled tuning and control systems for television receivers. It should be noted that the SAB3021 can be used with direct command decoding at the receiver by a microcomputer (for example the 8021), with the microcomputer also generating suitable signals for teletext control. This option provides a simple low-cost system.

Transmitter

The SAB3021 is the transmitter IC of the VTS systems (see Fig. 2.) If a command keypad with 64 keys and one two-position switch is used, the SAB3021 can transmit 128 different command codes. It is therefore suitable for controlling more than one system, for example radio, television and hi-fi. The command word consists of the 6-bit key code preceded by a start bit. The interval between the transmitted bursts indicates the logic state of the command word bits so that the word duration depends on the code being transmitted. Each burst of the transmission shown in Fig. 2 consists of six pulses lasting 154 µs. This allows selectivity to be used at the receiver, thus preventing the blocking of commands by background infrared radiation. The SAB3021 has two MODE inputs which determine the mode of operation (infrared or local) and the state of the start bit which precedes each command word.

Preamplifier and Receiver

The signal transmitted by the SAB3021 is detected by a photodiode, and then amplified by the preamplifier, integrated circuit TDB2033 (see Fig. 2.). The synchronous demodulator and AGC circuits ensure rejection of spurious signals, while the

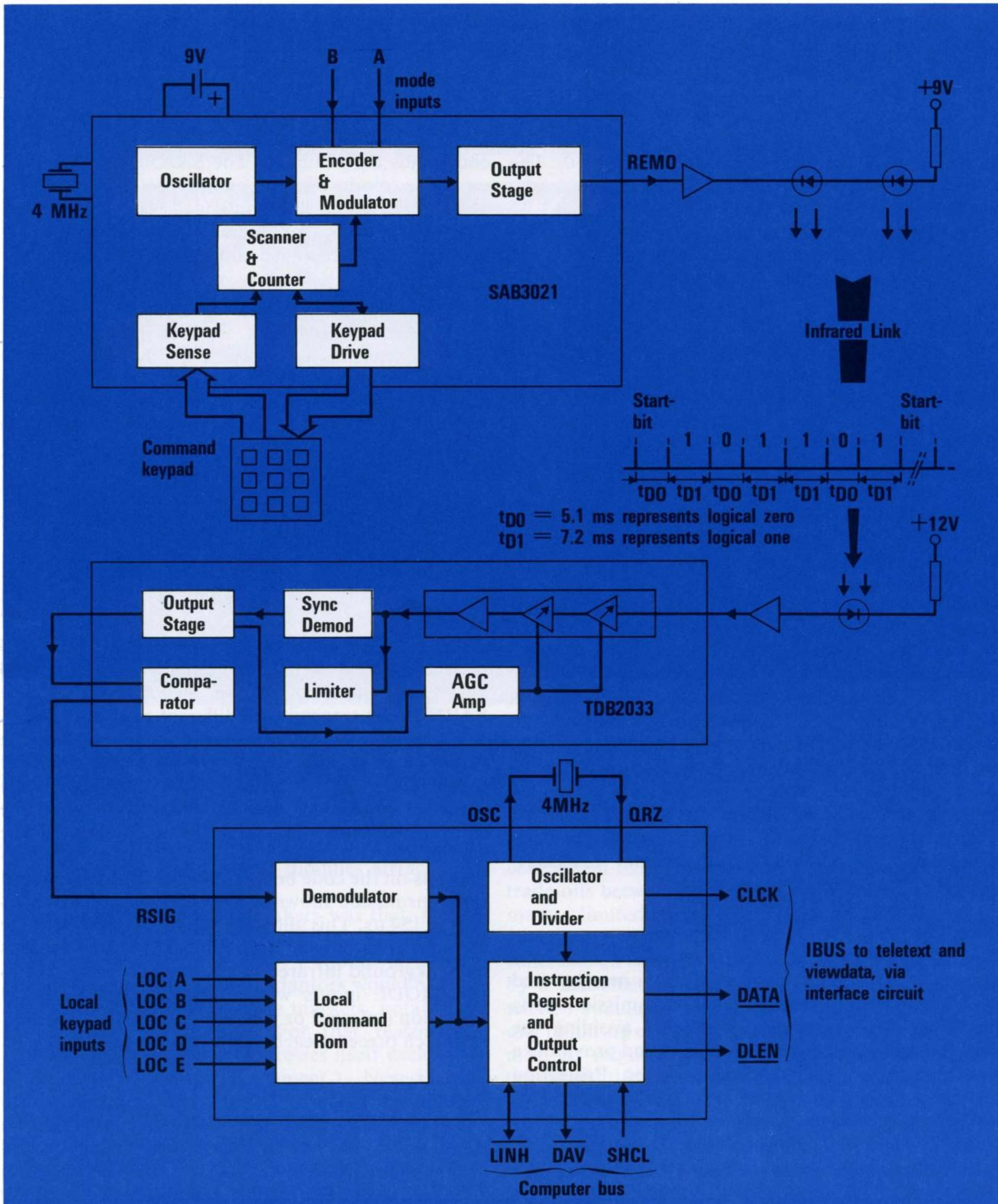

Fig. 2. Block diagram to illustrate the SAB3021/SAB3042 transmitter/receiver combination.

comparator provides a constant output level for a wide range of input amplitudes.

The SAB3042 is intended for use as a microcomputer peripheral and, as such, it will augment the software capability of a microcomputer in a remote control system.

SIGNAL PROCESSING—TELETEXT DECODER

Mullard's teletext decoder is based on four dedicated LSI ICs (three of them digital) and two standard 1 K × 4 static RAMs. A complete circuit is shown in Fig. 3.

The main functions of the four dedicated ICs are:

SAA5020 TIC	(timing chain)
SAA5030 VIP	(video input processor)
SAA5040 TAC	(teletext data acquisition and control)
SAA5050 TROM	(teletext read-only memory—character generator)

Variants of these ICs catering for different markets are available. To meet differing British, Continental and Australian requirements there are six versions of TAC; these vary in the on-screen display provided and in the decoding of remote-control commands. There are eight TROM integrated circuits giving a choice of English, Italian, French, German, Swedish, Hebrew and Cyrillic characters, plus ASCII. Two variants of the TIC—the SAA5025A and the SAA5025B—are produced to meet the requirements of the American 525-line television standard (system M). The three digital ICs (TAC, TIC, and TROM) are in N-channel MOS, whereas the VIP is a linear bipolar IC. The decoder also contains four low-power Schottky TTL integrated circuits which interface the page memory.

The present design not only meets immediate requirements but is also compatible with future developments, owing to the flexibility of the data highways and the partitioning of the system.

Taking the ICs in the order of the signal processing sequence, we shall look first at the video input processor.

SAA5030 VIP (Video Input Processor)

The VIP (IC1 in Fig. 3) comprises two separate sections: the data retrieval section, and the display clock generator. The IC is fed with the video signal

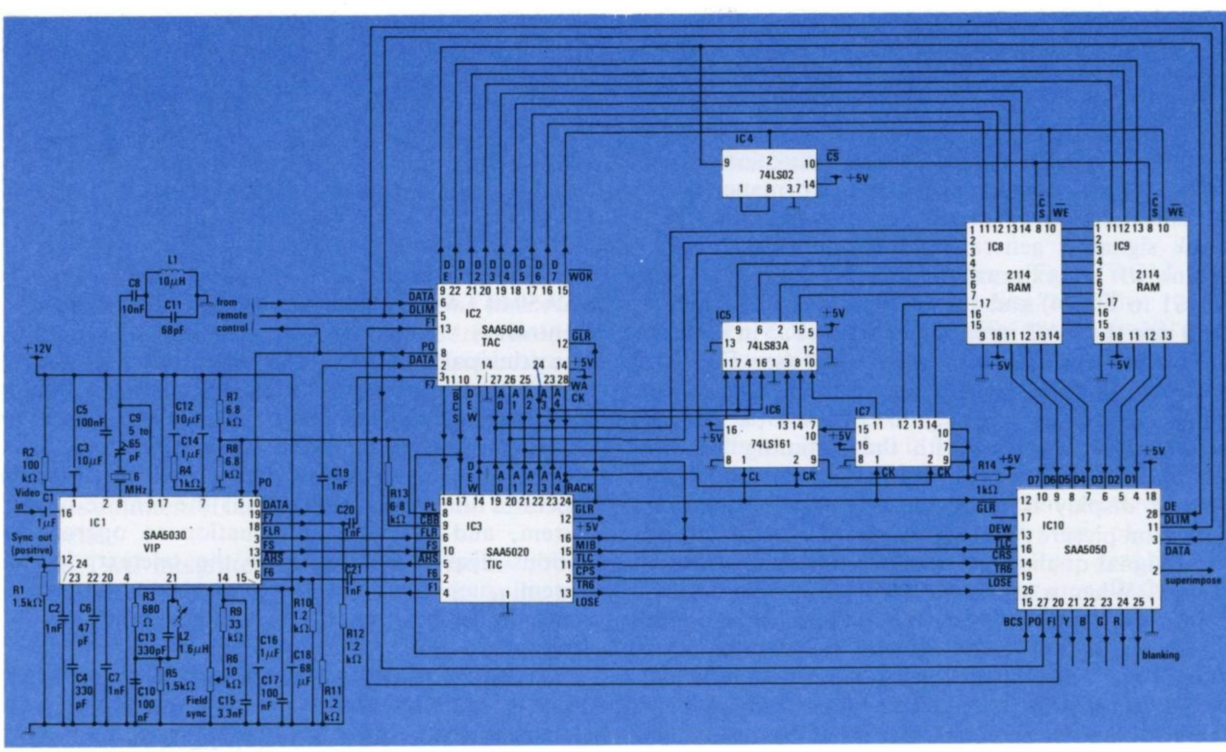

Fig. 3. Circuit diagram of teletext decoder incorporating 4 LSI integrated circuits.

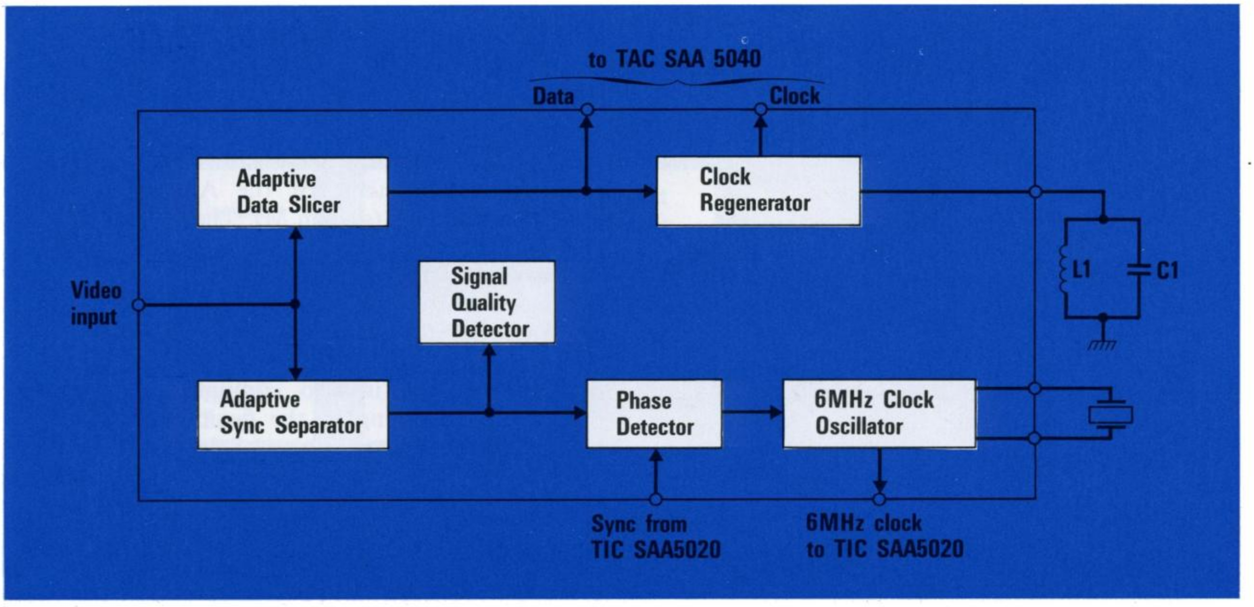

Fig. 4. Video input processor integrated circuit VIP (SAA5030).

from the television receiver. Figure 4 shows a simplified block diagram of the SAA5030 circuit.

The data retrieval section of IC1 slices the incoming data signal by means of an automatic adaptive data slicer circuit. This circuit sets the threshold level for slicing at half the data amplitude, regardless of the amplitude of the incoming signal, and provides some compensation for distortion such as co-channel interference; the performance of the system under noisy conditions is thus improved. A clock signal is generated from the sliced data by means of an external 6.9375 MHz tuned circuit (L1C1 in Fig. 4) and this signal is used to clock the data into the TAC integrated circuit (IC2 in Fig. 3).

The 6 MHz display system clock (see Fig. 4) is output from VIP, and divided in IC3 to produce a pulse every 64 µs. This signal is passed back to IC1 where it is compared with the incoming line sync signals. By this means, the timing system of the teletext display is phase-locked with the incoming television picture signal.

A 'signal quality' detector circuit is also included in IC1. When a signal with a high noise content is being received, or in the absence of an incoming signal, the signal quality detector cuts off the teletext data to IC2 and allows the display system to free-run. The detector thus prevents the data already stored in the memory from being corrupted by noise. This facility, combined with the local display clock, is required for after-hours display, when the TV picture is generated from the contents of the page memory in the absence of an incoming television signal.

Integrated circuit IC1 contains an adaptive sync separator which extracts the sync signals from the incoming video signal. It also provides a sync output signal for the timebases of the television receiver. When a full page of text is displayed, the sync output signal is derived from IC3 (described under SAA5020 TIC).

SAA5040 TAC (Teletext Data Acquisition and Control)

The principal function of the data acquisition section of the TAC integrated circuit (IC2 in Fig. 3) is to process the teletext data so that it can be written into the memory. Figure 5 shows a simplified block diagram of the SAA5040 circuit. The control section processes the information from the remote control system, and uses this information to operate the various display functions of the teletext decoder system, such as selection of television, teletext or viewdata modes, page select, page hold or time display.

The data acquisition section of IC2 divides the data from IC1 into its component parts. The Hamming-coded address words are checked, and words having a single wrong bit are corrected.

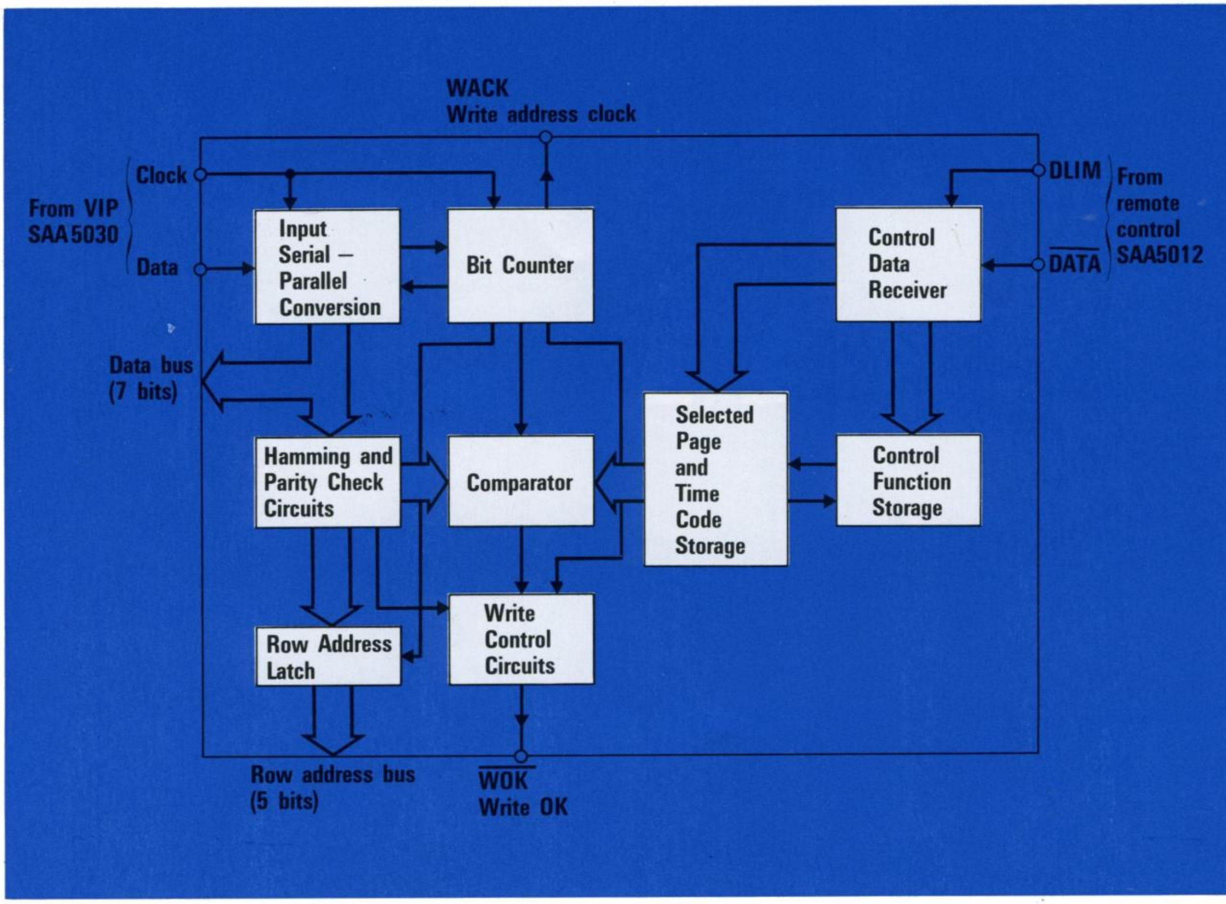

Fig. 5. Integrated circuit for teletext data acquisition and control—TAC (SAA5040).

Address words having two wrong bits are rejected. The row address of the incoming data line (one of 24) is fed by this section to the 5-bit row address bus, and the character data is fed through the data bus to the memory as a sequence of 40 7-bit parallel words.

A signal denoted as $\overline{\text{WOK}}$ ($\overline{\text{Write OK}}$) indicates to the memory when valid data is to be written in, and a WACK (Write Address Clock) signal causes the address counters (IC6 and IC7) to step on after each character.

The TAC integrated circuit also contains circuits for the implementation of the control bits in the page header.

SAA5050 TROM (Teletext Read-Only Memory)

The read-only memory of the TROM (IC10 in Fig. 3) converts the 7-bit character data from the memory into a dot matrix pattern. This matrix is in a 7-by-5 dot form for each character. The TROM also contains a 'character rounding' facility which effectively increases this matrix to 14-by-10 dots, giving improved definition to the displayed characters. Figure 6 shows a simplified block diagram of the SAA5050 circuit.

Circuits are included in IC10 which enable various control functions to be performed. These functions are determined by control characters received from the memory. Examples of the use of control functions include the selection of graphics or alphanumeric, 'flashing' words, or newsflashes and subtitles displayed in boxes within television pictures.

A 'concealed display' function which can be operated by the user is also provided by IC10. For example, if a quiz-page is transmitted, containing both a question and an answer, the answer can initially be concealed until the user chooses to reveal

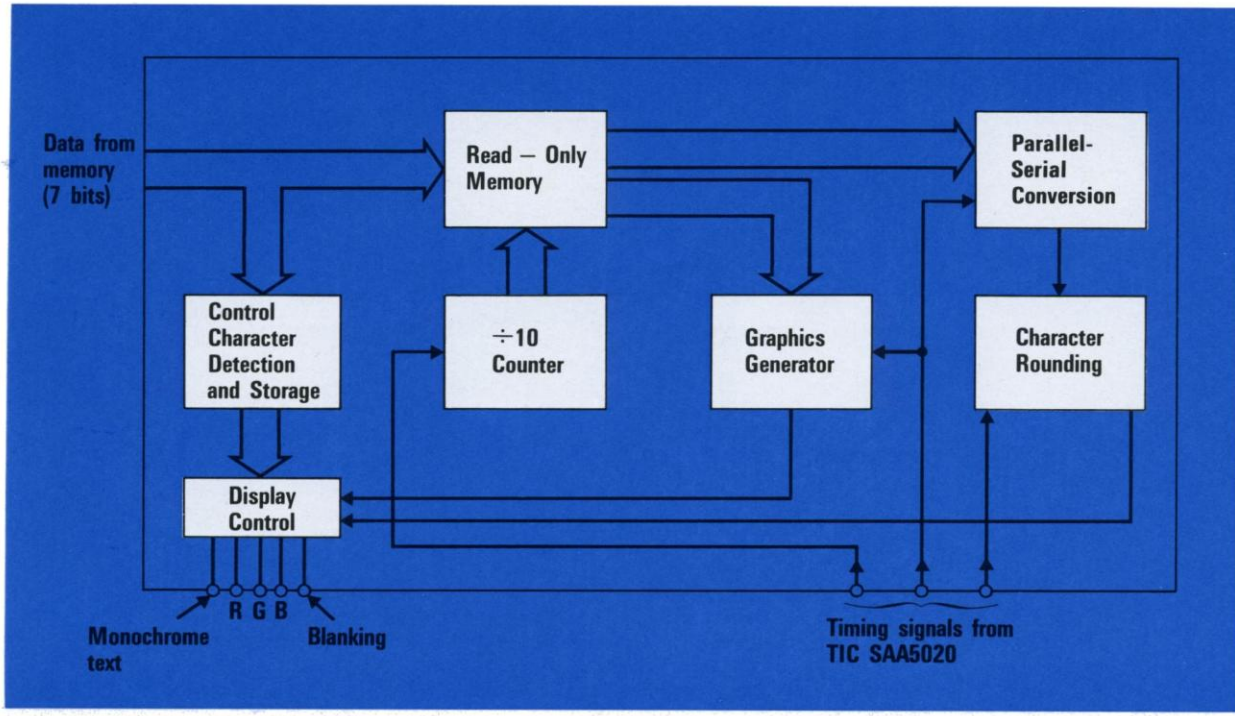

Fig. 6. Character generator integrated circuit TROM (SAA5050).

it. The remote-control system IBUS is connected to TROM for this and similar functions.

Timing signals are fed to IC10 from IC3. Character video output signals are provided by IC10, and these comprise a monochrome-only signal and RGB signals for a colour receiver. The blanking output signal enables the television video signal to be blanked out when a teletext newsflash or a subtitle is to be displayed (HIGH gives 'picture blank', LOW gives 'picture on'). The blanking-out takes the form of a 'black box' around the teletext characters.

The monochrome text signal (Y) is provided for monochrome displays; that is, it does not include background video information. However, it is also necessary if, in a normal colour display, inlay of characters into the television picture is required; it is then used as an inlay blanking signal. When text and video are mixed, the readability of the display is greatly improved if the text is inlaid, rather than simply added on to the television video. The readability is further enhanced if the picture contrast is automatically reduced when text and video are mixed. This can be performed by using the 'superimpose' output available from the teletext decoder.

MEMORY

The memory block consists of two 1K×4 static RAMs (IC8 and IC9 in Fig. 3). These RAMs are arranged as four 32-by-32 matrices, each storage location being selected by means of a binary code on 10 address lines. However, the teletext display is organised as a 40-by-24 matrix (24 rows of 40 characters per row) with 5-bit row addresses and 6-bit column addresses. Therefore, the 74LS83A adder (IC5 in Fig. 3) converts the 11 bits of display address into a 10-bit address code for the selection of one of the 960 locations in the RAMs. The RAMs have dual input/output pins (pins 11 to 14) and to avoid conflicts on the data bus when the memory is activated, the 74LS02 NOR gate is included (IC4 in Fig. 3).

SAA5020 TIC (Timing Chain)

The divider stages in the TIC integrated circuit (IC3 in Fig. 3) subdivide the 6 MHz clock signal from IC1 down to 25 Hz, the television frame rate, and generate all the timing signals for the teletext display. Figure 7 shows a simplified block diagram of the SAA5020 circuit. During the display period, a 1 MHz clock signal RACK (Read Address Clock) takes over

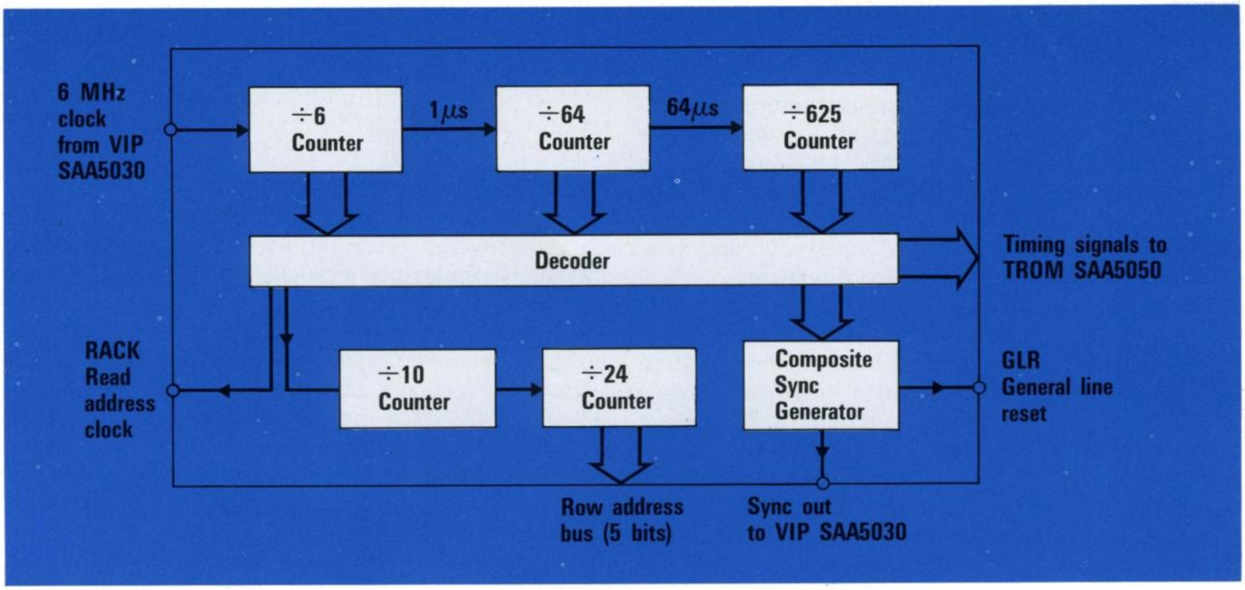

Fig. 7. Timing chain integrated circuit TIC (SAA5020).

from WACK to step the character addresses. The address counters IC6 and IC7 are cleared at the end of every line and reset to the first position. After every ten lines during the display, IC3 steps the row address on by one to access the next row of characters in the memory.

In addition to providing all the timing signals for the display, IC3 also generates a complete composite sync signal. This signal can be used to drive the timebases of the television receiver in the absence of transmitted sync during after-hours operation.

SIGNAL PROCESSING—INTERFACING WITH TV RECEIVERS

The interface between the teletext decoder and conventional TV circuits is shown in Fig. 8. The principal input signal is a composite TV video waveform of 2.4 V peak-to-peak amplitude (negative-going sync) supplied through a 6 MHz sound carrier trap from the video demodulator. The decoder requires two supplies, 5 V (450 mA) and 12 V (120 mA), and two inputs from the control system, DLIM and $\overline{\text{DATA}}$. The outputs from the decoder are as follows:

(1) Synchronising signal to TV timebases
(2) RGB text outputs to TV display circuits
(3) Monochrome text output
(4) Blanking signal carrying TV picture and blanking information

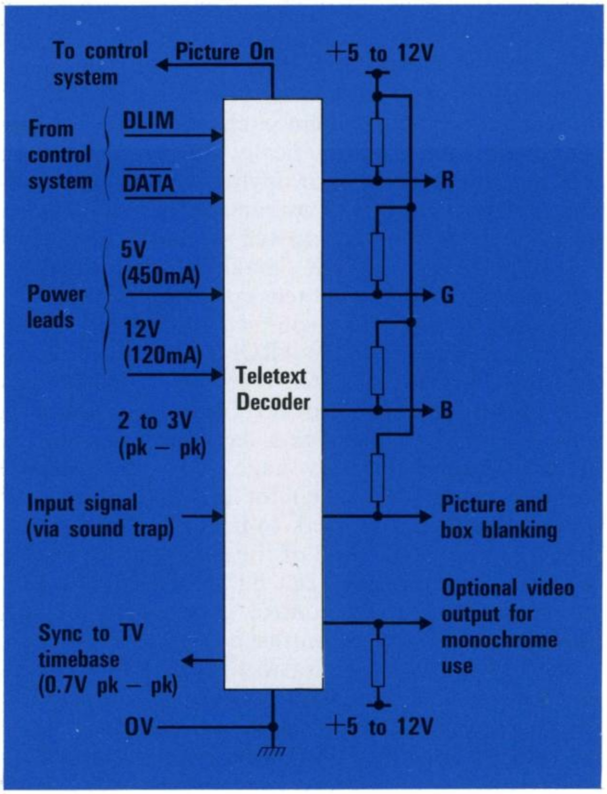

Fig. 8. Teletext decoder/TV receiver interface.

(5) Picture On output, PO, for the control of the TV analogue control functions
(6) Superimpose output

The synchronising signal consists of either a white-clipped version of the composite TV signal or a locally-generated sync waveform. The polarity of this waveform depends on the voltage to which the load resistor is connected, and the amplitude of the sync component is approximately equal to the sync component of the incoming video waveform.

The teletext decoder can supply drive signals which are capable of generating a clear, error-free display. However, the end result can obviously be impaired by poor incoming signals or a low-performance tuner, IF amplifier, video drive circuit or TV picture tube. A television receiver designed to give a subjectively good picture for normal TV viewing will not necessarily give a teletext display of similar quality. Close attention should be paid to the tuner, IF amplifier and video demodulator to optimise teletext reception while careful design of the video drive circuitry ensures the sharpest possible display.

Mullard has now developed a single-chip PAL colour decoder, the TDA3560. This IC performs all the colour decoding and matrixing functions in the television receiver, and also incorporates linear accurately-tracked DC control of contrast in both the luminance and chrominance channel. An on-chip peak-white limiter automatically reduces the contrast setting if the peak level of any of the output signals exceed 9.3 V. The circuit contains separate inputs for data insertion, analogue as well as digital, and a fast video blanking facility, making it particularly suitable for the display of teletext information.

Figure 9 shows a complete interface circuit between the SAA5050 TROM (in the teletext decoder) and the TDA3560. The voltage signals from each of the data outputs of the TROM are clipped by a diode, D1, D2 or D3, at a level equivalent to the desired channel drive voltage. The input signal required by the TDA3560 for a 5 V peak-to-peak output signal is 1 V peak-to-peak. For the circuit shown in Fig. 9, the level of the data contrast setting is preset. Modifications can be made to this circuit which give a contrast control of the data display, linked to the TV video contrast control.

The full page, or boxes within the page, can be blanked out using the blanking output from TROM; the Y signal is used to blank out the video signal when text is inlaid into the television picture. Video-data switching times are very short—less than 20 ns—avoiding coloured edges on the inserted signals on the screen. The superimpose output from the TROM goes LOW when mix mode is selected, and this output is connected to the contrast control of the TDA3560 to reduce the TV picture and thus make the text easily legible.

VIEWDATA-COMPATIBLE LUCY

Viewdata, which disseminates and retrieves computer-based information over telephone lines, has many similarities with teletext. Technically, page format and data encoding are performed in much the same manner, and in a more general sense they are aimed at an overlapping potential market. From a variety of vantage points, therefore, it appeared advantageous from the earliest days of development to allow for a high degree of component compatibility between the two technologies. Mullard, in particular, determined from the outset that a high priority would be placed on keeping costs down, to the advantage of both systems. This required an approach to components development that combined, insofar as it was possible, the functions of both.

The outcome of that approach has been a full LSI viewdata and teletext receiver system based on a microprocessor from the standard 8048 family. This is used in combination with the purpose-designed LSI circuit type SAA5070, now popularly know as LUCY, which is intended to integrate as many as possible of the telephone line fixed hardware functions of a viewdata receiver.

LUCY, like the Mullard teletext ICs, is manufactured in N-channel MOS but encapsulated in a 40-pin dual-in-line package. Included in the SAA5070 are the:

(*a*) Microprocessor interface
(*b*) 1200 baud demodulator and asynchronous receiver
(*c*) 75/1200 baud modulator and asynchronous transmitter
(*d*) Autodialling circuit for British Telecom and European requirements
(*e*) Tape recorder modem (modified 'Kansas City' standard)
(*f*) Tape recorder asynchronous receiver/transmitter
(*g*) IBUS receiver and receiver/transmitter
(*h*) General input/output ports for other subsystems (such as an EAROM)
(*i*) Timer circuits (60 s and 1.5 s time-outs)

A simplified block diagram indicating the internal organisation of LUCY is shown in Fig. 10. The SAA5070 is partitioned for flexibility of use so that,

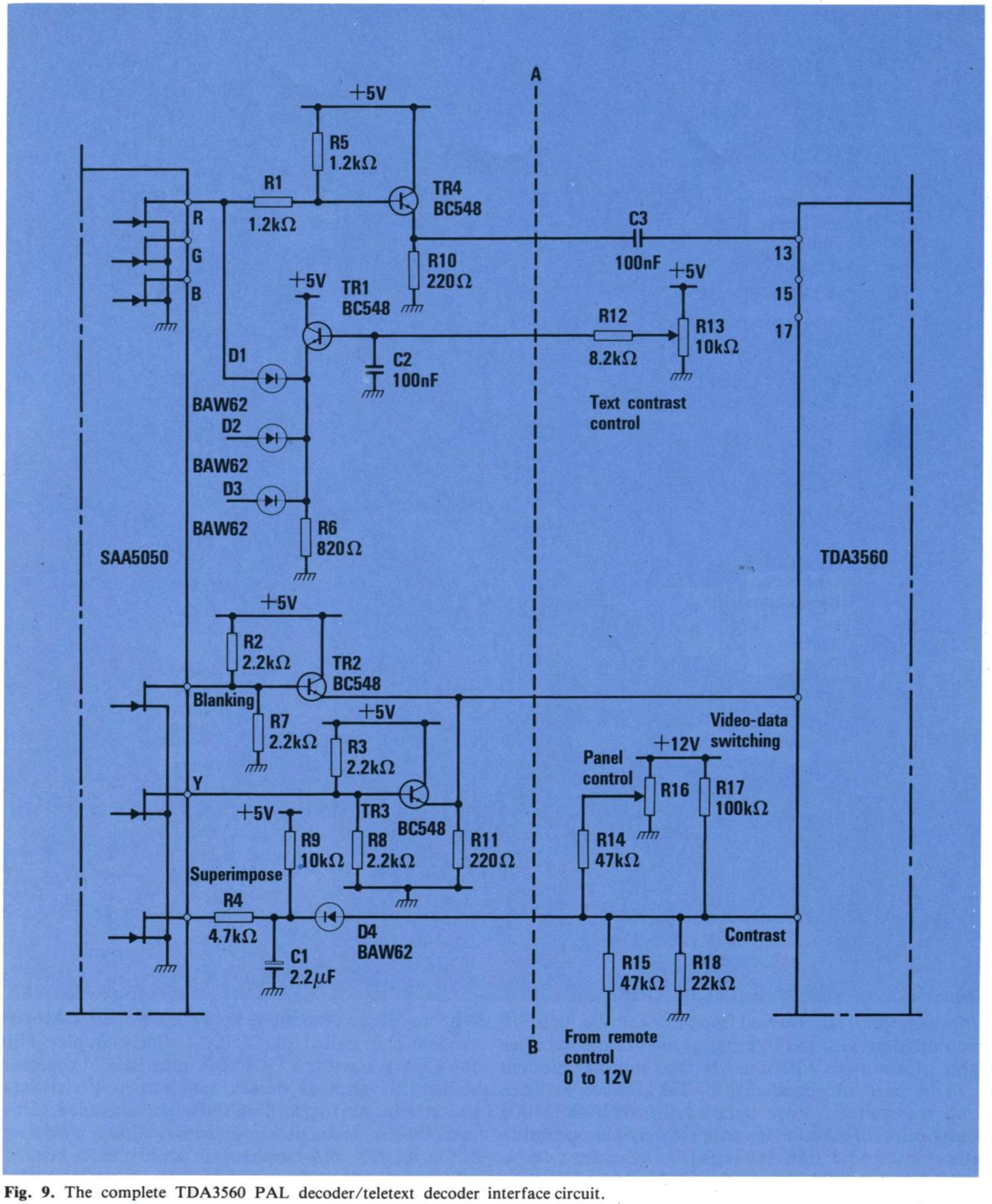

Fig. 9. The complete TDA3560 PAL decoder/teletext decoder interface circuit.

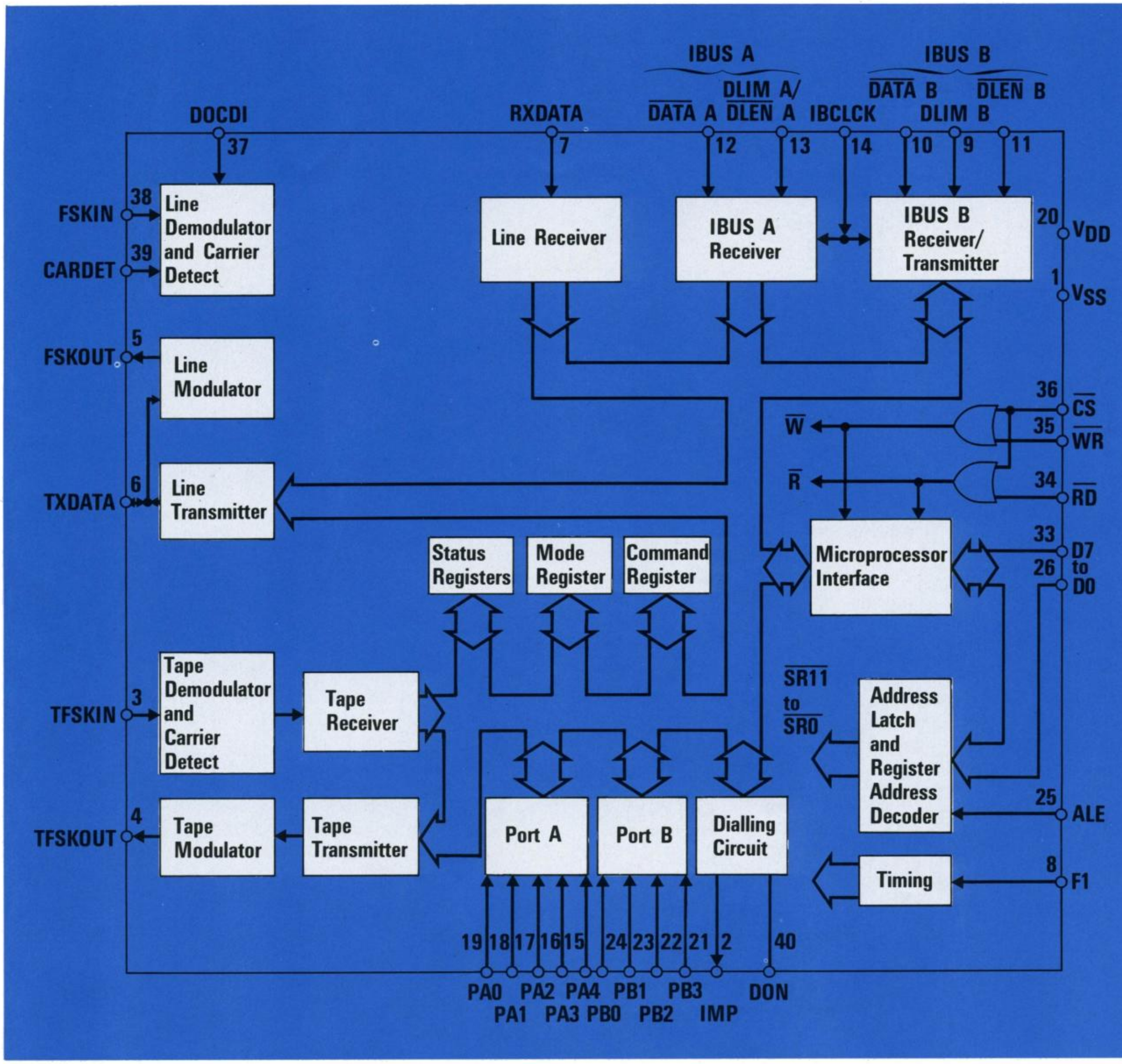

Fig. 10. Simplified block diagram of viewdata system integrated circuit LUCY (SAA5070).

for example, an internal modem can be used in conjunction with the internal asynchronous receiver and transmitter. Alternatively, the internal modem can be used independently of the internal receiver and transmitter. More detailed information and a description of a basic viewdata receiver incorporating the LUCY integrated circuit, is contained in a Mullard technical publication[1]. Readers may also wish to enquire about a newly developed analogue modem chip called LUCINDA, which couples with the LUCY circuit. LUCINDA and LUCY together reduce the number of ICs required in a viewdata decoder by up to 25. LUCINDA is scheduled to be available in production quantities by Easter 1983.

The LUCY integrated circuit also offers a host of additional facilities suited to an extended

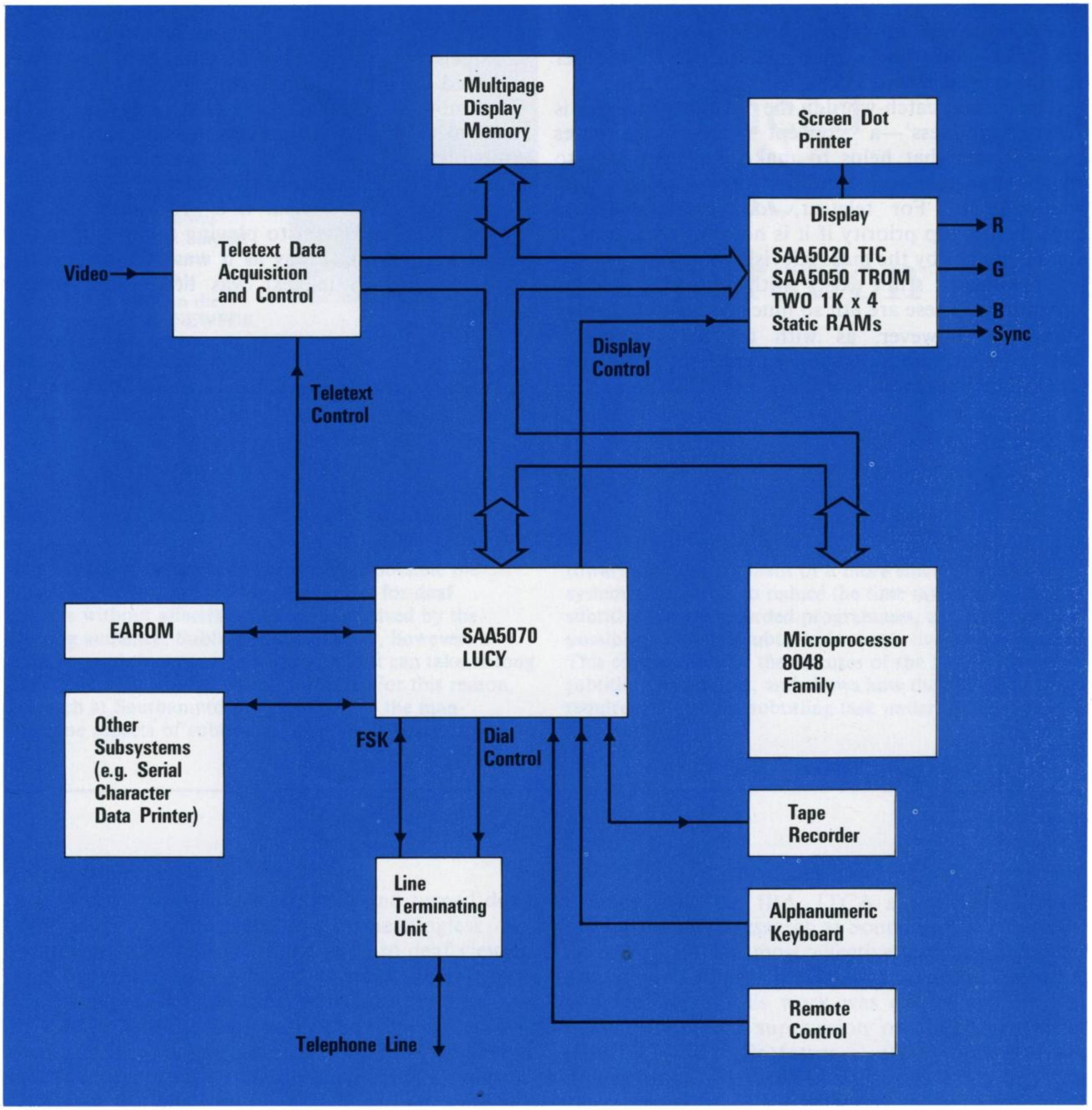

Fig. 11. Block diagram of an extended-specification viewdata receiver.

specification viewdata receiver. These facilities could include, for example, multipage random access memory, a full editing keyboard and a hard-copy printer. A block diagram of an extended specification receiver is shown in Fig. 11.

USING TELETEXT—TODAY AND TOMORROW

Continued success for teletext and teletext development in the UK and abroad depends on more than IC technology, of course. Mullard is keenly

aware that every element—from the broadcaster, component maker, setmaker and supplier to the customer—must be co-ordinated and served in order for the market to grow.

The current catch-word in the computer industry is 'user-friendliness'—a concept that incorporates every aspect that helps to make a system easy to understand, easy to use and responsive to individual requirements. For teletext, too, user-friendliness must be the top priority if it is not only to appeal to but be bought by the mass television market.

Drawbacks still exist with current teletext operations. These are not so much to do with display standards, however, as with the way in which teletext is accessed. Response times, in particular, need to be improved, and there is considerable scope existing within Level 1 technology to achieve this. Mullard is contributing by the development of a multipage chip, which allows a number of pages to be searched for and captured, for retrieval on demand. Even more-intelligent remote control devices can be made available, and setmakers and broadcasters can contribute in a variety of ways to improving the appeal and convenience of the system.

The future for teletext is a promising one, and Mullard's commitment to playing a key part in that future is as strong today as it was in those exciting early days when teletext was little more than a concept.

Reference

1. 'The LUCY Generation', Mullard Technical Publication M81-0001.

ANDREW LAMBOURNE gained a B.Sc. in Electronic Engineering at the University of Southampton in 1979. After graduating, he stayed on to join a Man-Machine Systems research group in the Electronics Department, and specialised in systems and techniques for television subtitling. In 1982 he was awarded a Winston Churchill Fellowship to visit North America as part of this research. His work on the development of the NEWFOR subtitling system is currently funded by the IBA and Oracle Teletext Ltd (OTL). *Photograph courtesy of Southern Newspapers.*

NEWFOR—An Advanced Subtitle Preparation System

by A. D. Lambourne

Synopsis
The advent of broadcast teletext makes possible the provision of optional television subtitles for deaf viewers without affecting the service received by the hearing audience. Subtitle preparation is, however, a complex and time-consuming task, and it can take as long as 30 hours to subtitle a 1-hour drama. For this reason, research at Southampton University into the man-machine aspects of subtitle preparation is being directed towards the development of a more efficient subtitling system. The aim is to reduce the time taken to prepare subtitles for pre-recorded programmes, and to make it possible to provide subtitles for some live broadcasts. This chapter reviews the features of the NEWFOR subtitling equipment, and shows how they relate to the requirements of the subtitling task under different conditions.

INTRODUCTION

Watching television with the sound turned down readily demonstrates how meaningless and frustrating the silent pictures can be to deaf viewers. The provision of subtitles, however, can enable television programmes to be appreciated and enjoyed by the 6–8% of the population who have moderate to severe hearing impairment. Due to fears of adverse reaction from the majority hearing audience, television programmes in the UK are not generally subtitled with 'open captions' visible on the picture signal. Instead, 'closed captions' are transmitted on a dedicated teletext page and displayed under viewer control using a teletext decoder. ORACLE currently provide subtitles for an average of two-and-a-half hours of ITV programming per week; CEEFAX have recently expanded their closed captioning operation and now subtitle about five hours per week.

Since 1978, the IBA, ITCA and Oracle Teletext Ltd have funded research at Southampton University to investigate the most effective techniques for the production and presentation of teletext subtitles. The initial phase of this work was carried out by Rob Baker, under the supervision of Dr. Alan Newell (now NCR Professor of Microprocessor Engineering, Dundee University). Demonstration videotapes of decoded teletext subtitles were shown at clubs for the deaf and hard-of-hearing throughout the UK, and on the basis of viewer reaction, guidelines for subtitle presentation were formulated.[1,2]

The preparation of subtitles for transmission with a pre-recorded programme is a time-consuming process, and has been found to take between 20 and 30 hours per programme hour. In 1981, the

Southampton project was therefore extended to include the development of efficient subtitle preparation equipment, based on previous research into preparation techniques and the tasks involved in subtitling. The advanced NEWFOR subtitling system is the prototype of the equipment that will be used by ORACLE for service subtitling. This chapter describes the features of the NEWFOR system, and shows how they relate to subtitle preparation requirements.

OPERATIONAL REQUIREMENTS

Subtitles for pre-recorded programmes are generally prepared in advance of transmission and stored on floppy disk. Access to the programme recording is usually by means of a ¾″ U-matic dub, timecoded to match the programme master tape; a script is also normally available. Subtitling thus takes place entirely separately from programme production and editing, since the timecoded dub provides a reference to the master tape. Similarly, the off-line preparation of teletext subtitles can be separated from the remainder of the technical and editorial procedures concerned with the provision of a teletext service, since the subtitle file need not be accessed by the teletext computer until the associated programme is broadcast. Subtitling can therefore be carried out at purpose-designed workstations, of which NEWFOR is one prototype. The basic system consists of a microcomputer with dual disk drives and terminal, a video cassette recorder and colour monitor, and a timecode reader. Decoding and switching circuitry is used to superimpose subtitles in teletext format on to the video signal from the VCR. A photograph and block diagram of the workstation components is given in Fig. 1.

As with the design of any interactive computing system, the aim has been to enable the tasks involved in the subtitling process to be shared between the human operator and a computer. To achieve an effective division of tasks, it is necessary to assess the aptitudes of each 'partner' in the interactive system. Computers are suited to routine, repetitive and predictable tasks, whereas a subtitler will be equipped with complex linguistic skills and the abilities to make subjective decisions and to direct procedures. It would be a mistake, for example, to require the human operator to count characters to determine whether a subtitle text will fit on one or two lines; similarly it is not yet reasonable to require a computer to edit a programme script by two-thirds and produce sensible subtitles.

In addition to task division, it is important to establish an effective communication dialogue between subtitler and computer, for without this the overall efficiency of the system will be impaired. NEWFOR has a hierarchical structure of commands, which are grouped into operating modes corresponding to the preparation strategies adopted by the subtitlers. Within each mode, the available commands are listed in a menu, and are invoked by typing the first letter of the command. The menu acts as a prompt to the user, who need not therefore memorise the commands; a 'Help' option also displays an expanded menu with an explanation of the function of each listed command if required (see Figs. 2, 3). Labelled function keys on the keyboard enable subtitle display parameters, such as colour

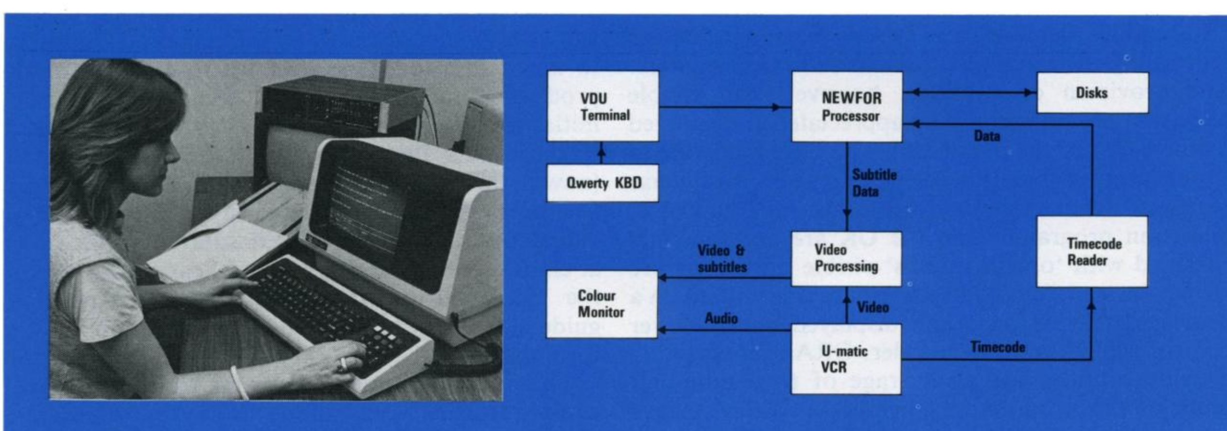

Fig. 1. Photograph and block diagram of the NEWFOR subtitling workstation.

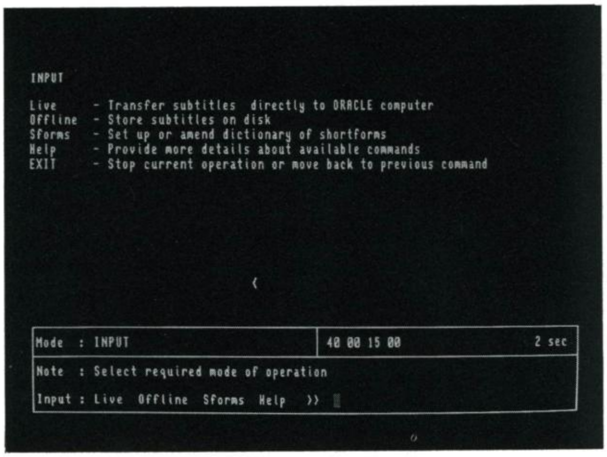

Fig. 2. VDU display showing a typical command menu with 'Help' option.

and position, to be specified. Defaults are used to reduce the number of commands or keystrokes required for each operation. The aim has been to make the system as straightforward as possible to operate. This minimises operator training time, reduces the potential for error, and increases efficiency.

Operating conditions will differ depending on whether the programme to be subtitled is prerecorded or live. As already mentioned, subtitles for prerecorded programmes are generally stored on floppy disk and synchronised using timecode. Insertion into the teletext magazine during transmission is under automatic control. If timecode synchronisation is not available, subtitles can be cued out manually using a pushbutton. This technique has been used regularly in Sweden—the disadvantages being that the timing accuracy is reduced, the task requires high concentration, and the subtitler has to be on-site at transmission time. Manual cueing is used by ORACLE only during prescripted portions of live programmes for which subtitles have been prepared in advance. Truly live material must be subtitled in real-time, and this places the greatest demands on the equipment and the subtitler. The problems of live subtitling will be considered in a later section, but first the processes involved in subtitle preparation are examined in more detail.

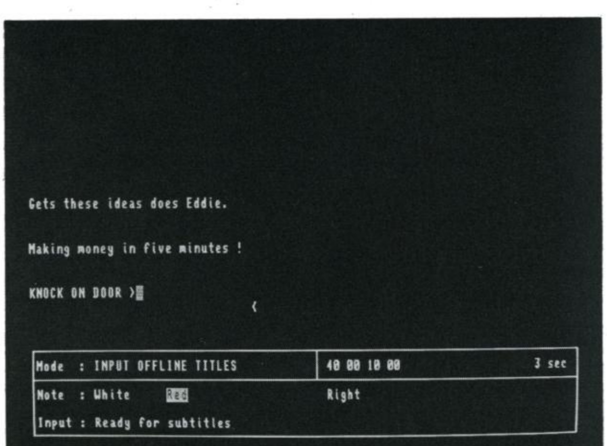

Fig. 3. Subtitle input.

SUBTITLE SCRIPT PREPARATION

A subtitle script is normally prepared by manually editing a programme script to about 120 words per minute (a slower word rate is used for children's programmes). In a typical programme having a speech rate of 180 wpm, the script must therefore be edited by about one third. Editing strategies are outlined in the subtitling guidelines[2] and will not be examined in detail here. Briefly, however, the keywords of an utterance are preserved where possible, while making the sentences more straightforward and therefore easier to read quickly. Supplementary information relating to background noises or effects not obvious to the deaf audience is also provided. The subtitler aims to convey sufficient information to enable the viewer to appreciate and enjoy the programme, without imposing an impossible reading load. Review of programme tape with the script enables notes to be made regarding subtitle placement, for it is helpful to the deaf viewer if subtitles are laterally positioned to match the on-screen position of the corresponding speaker. Further assistance is given in identifying a speaker by using differently coloured subtitles for different characters where possible. Notes can also be made on the script to indicate the time available for each segment, which will guide the later editing procedures.

If a script is not available, two options are open. The first, used by the National Captioning Institute in America, is for an audio typist to produce a typed transcript of the programme soundtrack. This takes about five hours per programme hour. Alternatively, a machine-shorthand transcription system enables a rough transcript to be produced in one unbroken pass through the programme, although spelling accuracy is reduced and this technique is more expensive. In the absence of a script, the second

option is for the subtitler to bypass transcription by listening to the soundtrack phrase-by-phrase, mentally editing each utterance, and directly typing subtitles into the computer system. For programmes requiring little or no editing this approach can be very successful and can significantly reduce preparation time. Rapid dialogue is difficult to handle, however, and the use of the 'direct input' method may in this case necessitate a lot of tidying up during subtitle review.

Pen and paper provides such a flexible editing medium that machine-based text editing systems are not yet generally used for subtitle script preparation. As computer input/output technologies advance to mirror the convenience of the traditional writing tools, and text-processing software becomes more sophisticated, it is likely that script editing will be undertaken with computer assistance. Ultimately a machine-readable programme-script will be accessed directly by an interactive editing system with which the operator can rapidly produce a subtitle file without ever having to retype the text.

TEXT INPUT AND FORMATTING

One of the tasks that is potentially the most time consuming during subtitle preparation is typing the subtitle script into the computer to produce a series of teletext-format subtitles on disk. Using a standard teletext page-editing terminal, this process can take more than eight hours per subtitled programme hour. The reason it takes so long is because of the number of operations that have to be undertaken manually for each subtitle. These operations are:

(1) Decide whether the subtitle will require one, two or three display lines and make appropriate formatting decisions.
(2) Type in the the text in the required format (this may require some juggling if text does not quite fit on a line).
(3) Insert control characters for colour, double-height and boxing.
(4) Position the subtitle to the left, centre or right of the screen and justify the line-starts.
(5) Calculate an appropriate on-air display time and enter it as a parameter.
(6) Initiate the disk storage operation.

Many of these tasks are tedious and repetitive—particularly the need to type five or six control characters per text line to produce the required display style. NEWFOR has therefore been designed to transfer such routine tasks to the computer, leaving the operator free to concentrate on text input. Using NEWFOR, the operator types the text for a subtitle and uses function keys to select display colour and position. Pressing a 'format' key causes the system to divide the text into an appropriate number of display lines according to its length. Decisions about where to break the text between lines are made automatically on the basis of linguistic as well as geometric criteria. This is because psycholinguistic research indicates that subtitles are easier to read and comprehend if line-endings are chosen at linguistically sensible places. For example, consider the following representations of the same sentence:

We found the dog at
last and took it home.

We found the dog at last
and took it home.

The second is more readable than the first because the line-ending corresponds to a syntactic boundary in the text.

Having formatted the subtitle, NEWFOR inserts the appropriate teletext control characters to produce a tidily boxed, coloured, double-height display. The text is left justified within the box, and the subtitle is positioned to the left, centre or right of the screen as required. Finally, an on-air time is automatically calculated according to a user-defined target display rate, and the completed subtitle is stored on disk. The automatic formatting facility has been found to halve the time taken to type in a subtitle file compared to the use of teletext page-editing console; it also makes the task considerably less tedious.

Synchronisation

To define the point in a pre-recorded programme at which each subtitle should appear, EBU/SMPTE timecode is used. Each 80-bit timecode word contains a count of hours, minutes, seconds and frames along the tape from some arbitrary start value, and the information is recorded on a spare audio track of the U-matic dub. Synchronisation of a subtitle file involves assigning to each subtitle a timecode value corresponding to the point on the tape at which the subtitle should be displayed. In a teletext application, this corresponds to the point at which the updated subtitle page is inserted into the broadcast teletext magazine.

Timecode input is most conveniently achieved by automatic data-logging at the press of a button. The computer loads the current output from a timecode reader and stores it on disk with the corresponding subtitle. The accuracy of the pushbutton

synchronisation method can be increased by running the tape at slow speed, or if required it can be 'frozen' at a particular frame and the timecode value typed in by hand. During the synchronisation procedure, a preview display is required of the next subtitle to be inserted, in addition to a subtitle-in-video display of the programme and current output.

Since the maximum display time of a subtitle is the difference between its timecode and the timecode of the successor that overwrites it, the NEWFOR computer can (by subtraction) determine whether sufficient on-air time is available for each subtitle. If not, the operator will be alerted and can either alter the insertion times or edit the offending text.

One of the guidelines for subtitle timing recommends that if a subtitle is to be inserted in the region of a picture cut, the optimum insertion time is just after the cut has occurred. If a subtitle overruns a cut, the visual stimulus of the cut can cause the viewer to re-read the text, thinking a new subtitle has appeared. If overrun does occur, the subtitle should be left on screen sufficiently long after the cut for the viewer to determine that the text has not changed. In the light of these factors, it would be useful for the subtitler to know the timecodes of picture cuts in relation to the subtitle times, and perhaps to adjust subtitles to improve the presentation. Although the assessment can be made visually, it would be expedited by a device which, fed with a video signal and timecode, could produce as an output the timecode of each detected picture cut. This information would be monitored by the NEWFOR computer, and used to assist the subtitler in timing subtitle insertions in the region of picture cuts.

Review and Correction

Replay of a subtitle file with the associated programme video is an important operating mode of the NEWFOR workstation. Timecode from the U-matic tape is automatically monitored by the computer and compared to the timecode of the next subtitle to be inserted. An offset may be added to simulate insertion delays in the broadcast teletext computer. When the timecode values match, the subtitle data is transferred to the display memory of teletext decoding circuitry, where it is combined with the programme video signal to produce a boxed subtitle in the picture. The result therefore corresponds to the display that would be produced on a domestic teletext receiver.

During replay, the subtitler assesses the accuracy of subtitle content, presentation and timing. Ideally, at least two reviews are carried out—once with sound and once without sound. When sound is available, the text content, synchronisation, colour and position can be checked. Replay without sound reveals the effectiveness with which information is transferred by the subtitles—for example, whether the programme can be understood adequately, whether background noises are subtitled where necessary, and whether sufficient reading time is available. It is an advantage if the final review can be performed by a deaf person, or by somebody who is not familiar with the programme content, since this more accurately represents the position of the intended audience.

Any necessary corrections could be made directly by stopping the replay and using the editing facilities, but corrections are more often noted on a subtitle printout and implemented in a separate editing phase. Efficient editing first requires rapid access to a particular subtitle. Provision is made for the operator to sequence rapidly forwards or backwards through the file, or to jump to a subtitle by specifying its timecode. To avoid typing the full 8-digit value, the timecode can be supplied to, say, the nearest minute (4 digits) and the sequencing controls used to home in on the required subtitle. If required, the system can also jump to the subtitle with timecode closest to that of the current tape position. Provision for the reverse procedure is planned, whereby the tape will automatically be wound to a point in the programme corresponding to the timecode of the current subtitle. The latter feature will minimise tape search-time when the operator wishes to replay a short sequence of subtitles intermediate in the programme.

When a textual edit has been made, the subtitle is automatically reformatted, thus removing the need to manually readjust the layout to compensate for the addition or deletion of words or characters. Changes to colour or position are specified using function keys as during subtitle input. For alterations which fall outside the capabilities of the automatic formatter, a more advanced page-editing system is currently being developed which will support word-wrap and automatic handling of control characters.

Alteration to timecodes can be made by repeating the synchronisation process for a short sequence of subtitles as described in the previous section. More likely, however, is the requirement to increase or decrease a particular timecode by an estimated offset. To avoid the need for calculation and retyping of the new value, the provision of function keys to

increment or decrement a timecode, by, say, 5 frames is foreseen. A similar feature, incrementing or decrementing in seconds, may be used to alter on-air time values.

Subtitling Live Programmes

Advance preparation of subtitles for pre-recorded material usually takes 20 to 30 times programme time. During an unscripted live broadcast, the subtitles must be composed, entered and formatted in one pass through the programme, and it is almost impossible to achieve the same presentation standards as achieved with prepared subtitles. The problem becomes one of trying to present the viewer with sufficient information to understand the programme, to present the information quickly enough for it to be in context, and to present it in a form which is easy to comprehend. These tasks can present serious problems for the subtitler, particularly during a rapid live presentation of unscripted material. Fortunately, however, few programmes are truly 'live' in the sense that no information is available beforehand about what will be said. Portions of live programmes are often prescripted, particularly coverages of major public events, church services and parts of news bulletins. If this information can be accessed and utilised quickly enough, subtitles for scripted portions can be prepared in advance and cued out manually during the transmission. The NEWFOR formatting software enables an untimecoded subtitle file to be created for this purpose in 3–4 times equivalent programme duration. Since time is available to review the file and correct any keying errors before transmission the manual cueing technique generally results in full and accurate subtitles—provided the speaker follows the script! Both Independent Television and BBC successfully integrated sequences of prepared subtitles into their live coverage of the Royal Wedding.

Programme material that is not prescripted cannot be subtitled by the manual cueing method. Instead, subtitles must be prepared live as the programme proceeds. Preparation of a subtitle involves deciding on its content, inputting the text, dividing it into lines, boxing and positioning it on the screen, and finally transmitting the data. The only parts of this procedure which cannot be automated are deciding what text to put in each subtitle, and typing the text into the computer. These will be considered in turn.

When deciding on the amount of text to put in each subtitle, two limits must be considered. Firstly, audience research shows that subtitles should not be presented at more than about 120 wpm otherwise the audience will not have time read them. Therefore, if a rapid presentation is to be subtitled, it may be necessary to edit 'on the move'. Secondly, the limiting rate of the text input technique must be considered. This again affects the amount of editing or summarising that is necessary. Editing and text input need not be handled by one person—it can be an advantage to have a trained 'editing interpreter' listening to the soundtrack and dictating subtitles to a keyboard operator.

Considering now the input of subtitle text during a live programme, two methods are under investigation. The first involves the use of a special machine-shorthand keyboard such as the Palantype in Britain or the Stenotype in the USA. A trained operator uses the keyboard to type a series of phonetic codes representing speech, and these are decoded by a computer to produce, so far as possible, a conventional transcription. However, due to ambiguities in the phonetic coding, complexities in spelling conventions, and operator errors, the spelling and word-boundary identification in the transcribed output is not always accurate. The resultant errors in subtitles can cause confusion to deaf viewers, although the error-rate is likely to be reduced as development continues.[3,4] An advantage of machine-shorthand input is that a rate of 120 wpm can be sustained relatively easily; a current disadvantage is the shortage in Britain of trained operators, coupled with the additional equipment costs.

An alternative technique for live text input is to use an ordinary QWERTY keyboard. NEWFOR provides software assistance to speed up subtitle input through the use of shortforms. A shortform is a two or three character abbreviation for a name or phrase that is expected to occur frequently in a programme. Before transmission, a list of such key words and phrases is produced on the basis of background research into the information that is likely to be presented. Appropriate shortform abbreviations are chosen by the keyboard operator and stored as a dictionary in the NEWFOR system. When a shortform is later typed as part of the text of a subtitle, the computer automatically detects it and substitutes the long form from the stored dictionary.

For example:

TYPED: The ccs lined the route from sa.
OUTPUT: The cheering crowds lined the route
from Speke Airport.

TYPED: At last, pj enters lmc.
OUTPUT: At last, Pope John Paul enters Liverpool Metropolitan Cathedral.

The advantage of the QWERTY input techniques are that it is cheap and straightforward, the operator does not need special training, and the output is generally in correctly spelt English. The disadvantage is that the input rate is limited to about 70–80 wpm, making it difficult to cope with rapid presentations such as live News bulletins. Summary subtitles produced by QWERTY input with shortforms have successfully been used by ORACLE for live sports, and coverage of major public events such as the Papal visit.

FUTURE DEVELOPMENTS

During the next three years, a significant increase is expected in the amount of television subtitling available to deaf viewers in the UK by means of teletext. The cost of providing this service is being minimised through the development of efficient subtitle preparation equipment and techniques. ORACLE are currently using the prototype NEWFOR system for regular service subtitling of pre-recorded programmes, and experiments with live subtitling have been conducted. It is likely that the final version of the system will be a hybrid live/off-line subtitling terminal with provision for input from machine readable scripts, QWERTY keyboard, and machine-shorthand transcription equipment. During live programmes, the operating mode will be selected according to the type of programme being subtitled and the amount of scripted information available; the mode may vary as the programme proceeds.

Although subtitles for nationally networked programmes can be prepared and transmitted relatively straightforwardly, distribution problems have to be solved before ORACLE can offer a regional teletext subtitling service. Adaptations to the teletext distribution procedures are being investigated to enable subtitle pages for regional programmes to be transferred to the corresponding regional magazine without concurrently appearing in other magazines. When this technique has been perfected, it will also be feasible to provide subtitles for television commercials. The latter proposal would be greatly facilitated by the direct storage of subtitle data on the master videotape, for example in the 'spare bits' of the EBU timecode, or as a teletext signal on a dedicated vertical interval line.

Finally, consideration is being given to the exchange of subtitles between different countries. If a programme that has been subtitled in America is purchased by a British television organisation, it is possible to transcode the subtitle data from the US Line 21 standard into UK teletext. As part of this procedure, the NEWFOR shortform techniques can be adapted to perform an automatic spelling conversion between American English and British English. The result is a timecoded teletext subtitle file, produced in only one pass through the programme.

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Télétexte—Les dix premières années

Par G. A. McKenzie

Résumé

L'auteur de ce chapitre passe en revue les développements qui se sont faits depuis la première retransmission Télétexte expérimentale en 1973. Ce chapitre décrit les perfectionnements apportés au système de diffusion actuel (c'est-à-dire le 'niveau l') et permettant l'addition future d'extensions offrant une gamme plus vaste de dispositifs d'affichage et de systèmes graphiques améliorés (les niveaux 2–5). Il est également fait mention des techniques de 'télélogiciel' permettant de transmettre des instructions informatisées (ou même des programmes informatiques complets) à un récepteur 'intelligent' disposant d'un microprocesseur intégré.

Perfectionnements Télétexte—Niveaux 1, 2 et 3

Par G. O. Crowther

Résumé

Ce chapitre décrit en détails deux stades de perfectionnement compatibles avec le système Télétexte actuel (niveau 1). Le niveau 2 offre un répertoire de caractères plus vaste ainsi qu'un plus grand choix de dispositifs d'affichage. Le niveau 3 introduit la redéfinition dynamique de jeux de caractères (DRCS) permettant d'utiliser des caractères supplémentaires (non romains) ainsi que des systèmes graphiques améliorés.

Niveau 4—Affichages graphiques Télétexte utilisant un code alphagéométrique

Par R. H. Vivian

Résumé

Ce chapitre décrit une forme perfectionnée de Télétexte, permettant un affichage graphique complexe tout en utilisant une transmission très efficace, comparable à celle des niveaux 1/2. Ceci est possible grâce à la transmission d'instructions 'alphagéométriques' sous forme de données Télétexte, décodées ensuite par un récepteur 'intelligent' comportant un microprocesseur. Dans un exemple type, l'utilisation d'une mémoire d'affichage de 38 kilobytes permet une résolution de 320 × 240 points, multipliant ainsi par plus de treize la qualité de résolution de l'affichage graphique en mosaïque du niveau 1.

La Gestion des Réseaux ORACLE

Par G. A. Johnson et J. N. Slater

Résumé

Le service Télétexte pour le réseau de télévision indépendante (connu sous le nom d'ORACLE) est fourni par l'Independent Television Companies Association (ITCA). La mise au point de ce service ORACLE est décrite en détails, depuis son tout début en tant que service expérimental dans la région de Londres jusqu'à sa dimension actuelle de réseau national utilisé sur le réseau de télévision indépendante (ITV) tout comme sur les réseaux de la quatrième chaîne (Channel Four).

En ce qui concerne la distribution des signaux, les réseaux ITV et Channel Four sont divisés en deux parties: tout d'abord, le réseau de lignes et liaisons hertziennes, loué auprès de British Telecom (BT) et assurant la transmission des signaux de télévision des centres de diffusion aux transmetteurs principaux puis, en second lieu, le réseau de rediffusion par transmetteurs et réémetteurs UHF assurant une bonne réception des signaux de télevision UHF même dans les régions les plus isolées du Royaume-Uni.

Cette gestion des réseaux nécessaires pour assurer une distribution nationale des signaux Téletexte a été encore compliquée par l'entrée en scène de la télévision du matin (TV-am), de la quatrième chaîne Channel Four en Angleterre et Sianel Pedwar Cymru au Pays de Galles. De plus, de nombreux responsables locaux des programmes ITV ajoutent leur propre journal ORACLE régional au service diffusé à l'échelle nationale.

Equipement pour réseaux de distribution

Par P. L. Mothersole

Résumé

Les signaux de données Télétexte sont retransmis dans la période de suppression verticale des signaux de télévision. Les données sont indépendantes du signal vidéo mais le signal peut être affecté par une distorsion de retard de groupe, apparaissant dans certains types de réseaux de distribution et particulièrement lorsque des liaisons radio constituent une partie de la chaîne de distribution.

La liaison du signal Télétexte à d'autres réseaux vidéo asynchrones se fait par ponts de données, celles-ci étant régénérées à la sortie par le procédé dé shuntage. Quel que soit le signal vidéo, on peut également utiliser des régénérateurs de données pour rétablir des données ayant subi une distorsion. Quelle que soit la nature de la distorsion des données à l'entrée, ces dispositifs doivent fournir à la sortie des signaux pleinement conformes aux spécifications.

Les ponts de données permettent, indépendamment du programme vidéo, de générer le signal Télétexte de manière centrale et de le retransmettre selon les besoins à un certain nombre de réseaux indépendants. Il est donc possible d'utiliser des réseaux de télévision complexes et très étendus pour retransmettre des signaux Télétexte, la régénération assurant, selon les besoins, l'élimination de la distorsion des signaux de données. Le signal Télétexte ainsi retransmis peut donc toujours être pleinement conforme aux spécifications de diffusion, quel que soit le signal vidéo.

Le signal Télétexte n'est retransmis que sur un petit nombre de lignes de la période de suppression verticale et les données sont en perpétuel changement. Ce chapitre décrit des techniques, tant manuelles qu'automatiques, permettant d'obtenir des mesures précises de la qualité du signal de données Télétexte sur les réseaux de distribution. Il décrit également des moyens d'essai spéciaux permettant de vérifier le fonctionnement des ponts de données et des régénérateurs devant recevoir des signaux d'entrée déformés.

Circuits intégrés pour récepteurs

Par le personnel du Mullard Application Laboratory

Résumé

Le succès du service Télétexte en diffusion nationale a dépendu de façon critique de la mise au point et de la production en masse de circuits intégrés de faible coût destinés à la réception d'émissions Télétexte. Environ 30% de tous les nouveaux téléviseurs achetés dans le Royaume-Uni sont à présent des modèles Télétexte, dont preque la totalité utilisent des composants ou modules Mullard. Mullard a fourni, jusqu'à présent, plus de trois millions de jeux de microplaquettes à des fabricants de récepteurs dans plusieurs dizaines de pays; ce laboratoire est par conséquent le plus important fabricant de circuits intégrés Télétexte dans le monde entier.

Se rendant compte que des ventes en masse ne seraient possibles que si l'équipement requis par le consommateur était relativement bon marché et très fiable, les responsables des émissions et les

fabricants de récepteurs se sont accordés pour choisir un système robuste utilisant la synchronisation existant déjà dans les signaux TV transmis. Tout en assurant une correction positive des erreurs, ce système ne nécessitait pas de technologie perfectionnée à microprocesseurs au niveau de l'utilisateur. Grâce à ce choix d'une orientation pragmatique visant l'utilisateur, à laquelle Mullard a appliqué sa considérable expérience en matière d'électronique, il a été possible de produire les jeux de microplaquettes Télétexte et de modules bon marché qui sont décrits dans ce chapitre.

NEWFOR—Un équipement de sous-titrage perfectionné

Par A. D. Lambourne

Résumé

L'apparition du système Télétexte permet de fournir aux téléspectacteurs sourds des sous-titres facultatifs sans toutefois affecter les émissions reçues par le public général. La préparation de ces sous-titres est, toutefois, une tâche complexe et très longue de telle sorte que le sous-titrage d'une dramatique d'une heure peut prendre jusqu'à 30 heures. C'est pour cette raison que les travaux de recherche de l'Université de Southampton, portant sur les aspects homme-machine de la préparation de sous-titrages, est orientée vers la mise au point d'un système de sous-titrage bien plus efficace. L'objectif de ces efforts est de réduire le temps de préparation de sous-titres pour des émissions préenregistrées et de rendre possible la diffusion de sous-titres lors de certaines émissions en direct. Ce chapitre passe donc en revue les caractéristiques de l'équipement NEWFOR de sous-titrage et démontre comment il répond aux besoins de sous-titrage dans diverses conditions.

Übersetzungen

Bildschirmtext—Die ersten zehn Jahre

von G. A. McKenzie

Zusammenfassung

Der Autor gibt einen Überblick über die Entwicklungen, die seit der ersten experimentellen Bildschirmtextausstrahlung im Jahre 1973 stattgefunden haben. Es werden Verbesserungen des gegenwärtigen Sendesystems (als 'Stufe 1' beschrieben), die zukünftige Erweiterungen gestatten, um einen größeren Spielraum von Anzeigeattributen und verbesserte Grafiken zu bieten (Stufe 2 bis 5), beschrieben. Die 'Telesoftware'-Technologie, die es ermöglicht, computerisierte Anweisungen (oder sogar ganze Computerprogramme) an einen 'intelligenten' Empfänger, der einen Mikroprozessor enthält, zu übermitteln, wird ebenfalls beschrieben.

Bildschirmtextverbesserungen—Stufe 1, 2 und 3

von G. O. Crowther

Zusammenfassung

Zwei Erweiterungsstufen, die mit dem gegenwärtigen Bildschirmtextsystem (Stufe 1) kompatibel sind, werden ausführlich beschrieben. Stufe 2 bietet einen größeren Zeichenvorrat und eine größere Auswahl an Anzeigeattributen. Stufe 3 führt dynamisch neu definierte Zeichenmengen (DRCS) ein, die zusätzliche (nicht in Magerdruck) Buchstaben und verbesserte Grafiken bieten.

Stufe 4—Bildschirmtext-Grafiken mit alphageometrischen Kodierungen

von R. H. Vivian

Zusammenfassung

Es wird eine verbesserte Bildschirmtextform, bei der unter Benutzung von sehr hoher Sendeleistungsfähigkeit—die mit den Stufen 1/2 vergleichbar ist—komplizierte Grafiken dargestellt werden können, beschrieben. Dies wird durch die Sendung von 'alpha-geometrischen' Anweisungen in Form von Bildschirmtextdaten ermöglicht, die dann von einem 'intelligenten' Empfänger, in den ein Mikroprozessor eingebaut ist, entschlüsselt werden. Als typisches Beispiel ermöglicht die Benutzung eines Anzeigenspeichers mit einer Leistung von 38 Kilobytes eine Auflösung von 320×240 Bildschirmelementen, d.h. die Auflösung von mosaikgrafischen Elementen der Stufe 1 wird um mehr als das 13-fache verbessert.

Die Ausstrahlung von ORACLE

von G. A. Johnson und J. N. Slater

Zusammenfassung

Der Bildschirmtextdienst von Independent Television (unter dem Namen ORACLE bekannt) wird im Auftrag von der Independent Television Companies Association (ITCA) ausgestrahlt. Die Entwicklung des ORACLE-Dienstes wird, von den frühesten Anfängen als ein Versuchsdienst in der Gegend von London bis zu einem Service der überregional sowohl vom Independent Television (ITV) als auch vom Fourth-Channel-Sendenetz ausgestrahlt wird, in allen Einzelheiten beschrieben.

Für Signalausstrahlungszwecke werden die ITV- und Fourth-Channel-Sendernetze in zwei Teilen in Betracht gezogen. Erstens die Zeilen- und Mikrokurzwellenverbindungen, gemietet von British Telecom (BT), die die Fernsehsignale von den Studios zu den Hauptsendern übertragen, und zweitens das Relaisnetz bestehend aus Mikrokurzwellensendern und Zwischenstationen, die dafür sorgen, daß Mikrokurzwellensignale auch die entfernteste Ecke des Vereinigten Königreiches erreichen.

Das Aufkommen des Frühstrücksfernsehens (TV-am), Channel Four und Sianel Pedwar Cymru (das vierte Programm in Wales) hat die Ausstrahlungsvereinbarungen, die gebraucht werden, um die überregionale Verteilung der Bildschirmtextsignale sicherzustellen, weiterhin kompliziert. Außerdem fügen viele ITV-Programm-Abnehmer zusätzlich noch ihre eigene lokale ORACLE-Zeitschrift dem überregional ausgestrahlten Service zu.

Ausrüstung für Ausstrahlung über Sendenetze

von P. L. Mothersole

Zusammenfassung

Bildschirmtextdatensigale werden in der vertikalen Leerperiode des Fernsehsignals getragen. Die Daten sind unabhängig vom Fernsehsignal, das Datensignal ist jedoch gegenüber Betriebsgruppenlaufzeitverzerrungen, die bei einigen Arten von Sendenetzverteilingssystem auftreten können, anfällig, besonders wenn Radioverbindungen Teil der Kette bilden.

Datenverbindungen werden benutzt, um das Bildschirmtextsignal mit anderen asynchronischen Fernsehsendenetzen zu verbinden, und die Daten werden am Ausgang im Rahmen des Verbindungsprozesses regeneriert. Datenregeneratoren können auch dazu benutzt werden, verzerrte Daten unabhängig vom Bildsignal wieder zu entzerren. Diese Einheiten müssen trotz jeglicher Verzerrung der Eingabedaten Datenausgabesignale entsprechend den gesamten Aufbauvorschriften geben.

Übersetzungen

Das Bildschirmtextsignal kann zentral erzeugt werden und nach Bedarf durch Benutzung von Datenverbindungen an eine Reihe von unabhängigen Sendenetzen unabhängig vom Bildprogramm-Material weitergegeben werden. Es können deshalb komplizierte und weitverstreute Fernsehnetze für die Ausstrahlung von Bildschirmtextsignalen benutzt werden, und die Auswirkungen von Verzerrungen auf das Datensignal können, wenn notwendig, durch Regeneration entfernt werden. Das ausgestrahlte Bildschirmtextsignal kann daher immer unabhängig vom Bildsignal auf dem vollen Ausstrahlungsniveau gehalten werden.

Das Bildschirmtextsignal ist nur auf ein paar Zeilen der vertikalen Leerperiode vorhanden, und die Daten wechseln andauernd. Es werden Methoden beschrieben, die es ermöglichen, genaue Messungen der Qualität des Bildschirmtextdatensignals in Verteilersendenetzen sowohl manuell als auch automatisch durchzuführen. Es werden ebenfalls besondere Prüfeinrichtungen zur Prüfung der Leistung von Datenverbindungen und Regeneratoren, die mit verzerrten Eingabesignalen arbeiten müssen, beschrieben.

Integrierte Schaltkreise für Empfänger

Von Mitarbeitern des Mullard Application Laboratory

Zusammenfassung

Der Erfolg von Bildschirmtexten als überregionaler Sendedienst kann hauptsächlich auf die Entwicklung und Massenproduktion von preiswerten integrierten Schaltkreisen für den Bildschirmtextempfang zurückgeführt werden. Ungefähr 30% aller neuen Fernsehgeräte, die in Großbritannien verkauft werden, sind jetzt Bildschirmtextmodelle und fast alle enthalten Mullard-Teile oder -Bausteine. Bis heute hat Mullard mehr als 3 Millionen Chipgeräte an Gerätehersteller in mehreren Dutzend Ländern geliefert und ist daher der größte Hersteller von integrierten Bildschirmtextschaltkreisen in der Welt.

Da die Sendestationen und Gerätehersteller erkannten, daß ein Massenabsatz nur erzielt werden könnte, wenn die von den Konsumenten benötigten Geräte verhältnismäßig billig und sehr verläßlich wären, einigten sie sich darauf, ein stabiles System zu wählen, das den Gleichlauf, der in den ausgestrahlten Fernsehsignalen enthalten ist, ausnutzen würde. Dieses System bot eine positive Fehlerkorrektur, erforderte aber dennoch keine hochmoderne Mikroprozessortechnologie am Empfänger. Die Wahl dieses pragmatischen, Benutzerorientierten Vorgehens, auf das Mullard dann seine ausgedehnte Elektronik-Sachkenntnis anwandte, hat die in diesem Kapitel beschriebenen preiswerten Bildschirmtext-Chipgeräte und -Bausteine möglich gemacht.

NEWFOR—Ein fortschrittliches Untertitelgerät

von A. D. Lambourne

Zusammenfassung

Das Aufkommen von Bildschirmtexten hat es ermöglicht, daß auf Wunsch Fernsehuntertitel für taube Zuschauer gesendet werden können, ohne daß der Empfang der hörenden Zuschauer beeinträchtigt wird. Die Herstellung von Untertiteln ist jedoch eine komplizierte und zeitraubende Aufgabe, und es kann bis zu 30 Stunden dauern, bis ein Schauspiel von einer Stunde Dauer mit Untertiteln versehen ist. Aus diesem Grund befaßt sich die Forschung über die Probleme Mensch-Maschine bei der Untertitelherstellung an der Universität von Southampton mit der Entwicklung eines besseren Untertitelsystems. Das Ziel ist, die Zeit, die darauf verwendet wird, vorher aufgenommene Programme mit Untertiteln zu versehen, zu verkürzen, und das Senden von Untertiteln für einige live ausgestrahlte Programme zu ermöglichen. Dieses Kapitel gibt einen Überblick über die Besonderheiten des NEWFOR-Untertitelgerätes und zeigt, wie sie mit den Erfordernissen der Untertitelherstellung unter unterschiedlichen Bedingungen in Zusammenhang stehen.

Traducciones

Teletexto—Los primeros diez años

Por G. A. McKenzie

Resumen

El autor revisa los desarrollos llevados a cabo desde la primera transmisión de teletexto en 1973. Se describe las intensificaciones del sistema de transmisión actual (referido como 'nivel 1') que permite ampliaciones futuras para conseguir un major margen de atributos de indicación y gráficos mejorados (niveles 2–5). También se menciona las técnicas de 'telesoftware', que permiten enviar instrucciones computerizadas (o incluso programas completos) a un receptor 'inteligente' que lleva incorporado un microprocesador.

Intensificaciones de teletexto—Niveles 1, 2 y 3

Por G. O. Crowther

Resumen

Se describen detalladamente dos etapas de intensificación compatibles con el actual sistema de teletexto (nivel 1). El nivel 2 ofrece un repertorio de caracteres más amplio y una mayor elección de atributos de indicaciones. El nivel 3 introduce grupos de caracteres redefinidos dinámicamente (DRCS) que permiten el uso de caracteres extra (no romanos) y gráficos mejorados.

Nivel 4—Gráficos de teletexto empleando codificación alfageométrica

Por R. H. Vivian

Resumen

Se describe una forma de teletexto intensificada en la que pueden presentarse gráficos complicados empleando al mismo tiempo una eficacia de transmisión elevada, comparable con la de los niveles 1 y 2. Esto es posible gracias a la transmisión de instrucciones 'alfageométricas' como datos de teletexto, las cuales son luego descifradas por un receptor 'inteligente' que lleva incorporado un procesador. Normalmente, empleando una memoria de indicaciones de 38 kilooctetos se consigue

una resolución de 320 × 240 pixels, aumentando trece veces la resolución del gráfico de mosaico de nivel 1.

La Red de ORACLE

por G. A. Johnson and J. N. Slater

Resumen

El servicio de teletext para Independent Television (conocido como ORACLE) se presta en nombre de la asociación de compañías de televisión independiente (ITCA). Se describe con todo detalle el desarrollo del servicio de ORACLE desde sus comienzos como servicio experimental en la zona londinense hasta un servicio a escala nacional tanto en las redes de televisión independiente (ITV) como en el cuarto canal.

Para la distribución de señales, las redes de ITV y del cuarto canal se consideran en dos partes: primeramente la red de líneas y enlaces de televisión alquilados de British Telecom (BT) que toman señales de televisión de los estudios centrales a los transmisores principales y, en segundo lugar, la red de retransmisión de transmisores de UHF y repetidores para asegurar que las señales de televisión de UHF alcancen los más remotos lugares del R.U.

Con la llegada de la televisión a la hora del desayuno (TV-am), el cuarto canal y Sianel Pedwar Cymru (el cuarto canal en el País de gales), se ha complicado aún más la disposición de redes requeridas para asegurar la distribución de las señales de teletext en todo el ámbito nacional. Además, muchos contratistas de programas de ITV están añadiendo sus propias revistas ORACLE regionales al servicio enlazado nacionalmente.

Equipo para distribución de redes

Por P. L. Mothersole

Resumen

Las señales de datos de teletexto son cursadas en el período de supresión vertical de la señal de televisión. Los datos son independientes de la señal de vídeo, pero la señal de datos es susceptible de distorsión de retardo de grupo, que puede ocurrir con algunos tipos de sistemas de distribución de redes, particularmente cuando hay radioenlaces formando parte de la cadena.

Se emplean puentes de datos para enlazar la señal de teletexto a otras redes de vídeo asíncronas y los datos se regeneran en la salida, como parte del proceso de puenteo. Los regeneradores de datos pueden emplearse también para restablecer los datos distorsionados, independiente de la señal de vídeo. Estas unidades deben proporcionar señales de salida de datos con las características originales a pesar de cualquier distorsión de los datos de entrada.

La señal de teletexto puede generarse centralmente y suministrarse a varias redes independientes según se requiera, con independencia del programa de vídeo, empleando puentes de datos. Por tanto, pueden emplearse redes complicadas y extensas de televisión para cursar señales de teletexto, con los efectos de distorsión de la señal de datos suprimidos donde sea preciso, por regeneración. La señal de teletexto transmitida puede pues mantenerse siempre con las características de radiodifusión completas, con independencia de la señal de vídeo.

La señal de teletexto sólo está presente en unas cuantas líneas del período de supresión vertical y los datos están cambiando constantemente. Se describen técnicas que permiten efectuar medidas exactas de la calidad de la señal de datos de teletexto en redes de distribución, tanto manuales como automáticas. Se describen también medios de prueba especiales para comprobar el funcionamiento de los puentes de datos y regeneradores que tienen que operar con señales de entrada distorsionadas.

Circuitos integrados para receptores

Por el personal del Mullard Application Laboratory

Resumen

El desarrollo y producción a gran escala de circuitos integrados económicos para recepción de teletexto fue un factor crítico para asegurar el éxito del teletexto como servicio nacional de radiodifusión. Alrededor del 30% de todos los nuevos aparatos de televisión vendidos en el R.U. son actualmente modelos de teletexto, la mayoría de los cuales utilizan componentes o módulos de Mullard. Hasta la fecha, Mullard ha suministrado más de 3 millones de 'chip-sets' (conjuntos de pastilla) a los fabricantes de aparatos en muchos países, siendo los mayores fabricantes de CI de teletexto de todo el mundo.

Reconociendo que sólo se podría vender en gran escala si el equipo requerido por el consumidor era relativamente barato y muy fiable, se acordó por los radiodifusores y fabricantes de aparatos decidirse por un sistema robusto empleando el sincronismo inherente en las señales transmitidas de televisión. Este sistema, que ofrece corrección de error efectiva, no requería tecnología de microprocesador avanzada para la recepción. La elección de esta solución pragmática, orientada al consumidor, a la que Mullard dedicó entonces todos sus considerables conocimientos electrónicos, ha hecho posibles los módulos y 'chip-sets' de teletexto económicos que se describen en este capítulo.

NEWFOR—Equipo de subtitulación avanzado

Por A. D. Lambourne

Resumen

La llegada del teletexto hace posible la provisión de subtítulos de televisión optativos para teleespectadores sordos, sin afectar el servicio recibido por el auditorio normal. La preparación de subtítulos es, sin embargo, una tarea complicada y larga, pudiendo tardarse hasta 30 horas para subtitular un drama de una hora. Por este motivo, la investigación sobre los aspectos hombre-máquina de la preparación de subtítulos, en la Universidad de Southampton, está siendo dirigida hacia el desarrollo de un sistema de subtitulación más eficaz. Su propósito es reducir el tiempo tardado en preparar subtítulos para programas grabados previamente, y hacer posible los subtítulos para algunos programas en directo. Este capítulo revisa las características del equipo de subtitulación NEWFOR, mostrando cómo se relacionan con los requerimientos de la tarea de subtitulación en diferentes condiciones.

IBA TECHNICAL REVIEW

1 Measurement and Control*
2 Technical Reference Book (3rd Edition)*
3 Digital Television*
4 Television Transmitting Stations*
5 Independent Local Radio*
6 Transmitter Operation and Maintenance*
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9 Digital Television Developments*
10 A Broadcasting Engineer's Vade Mecum*
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